Aviation Week & Space Technology

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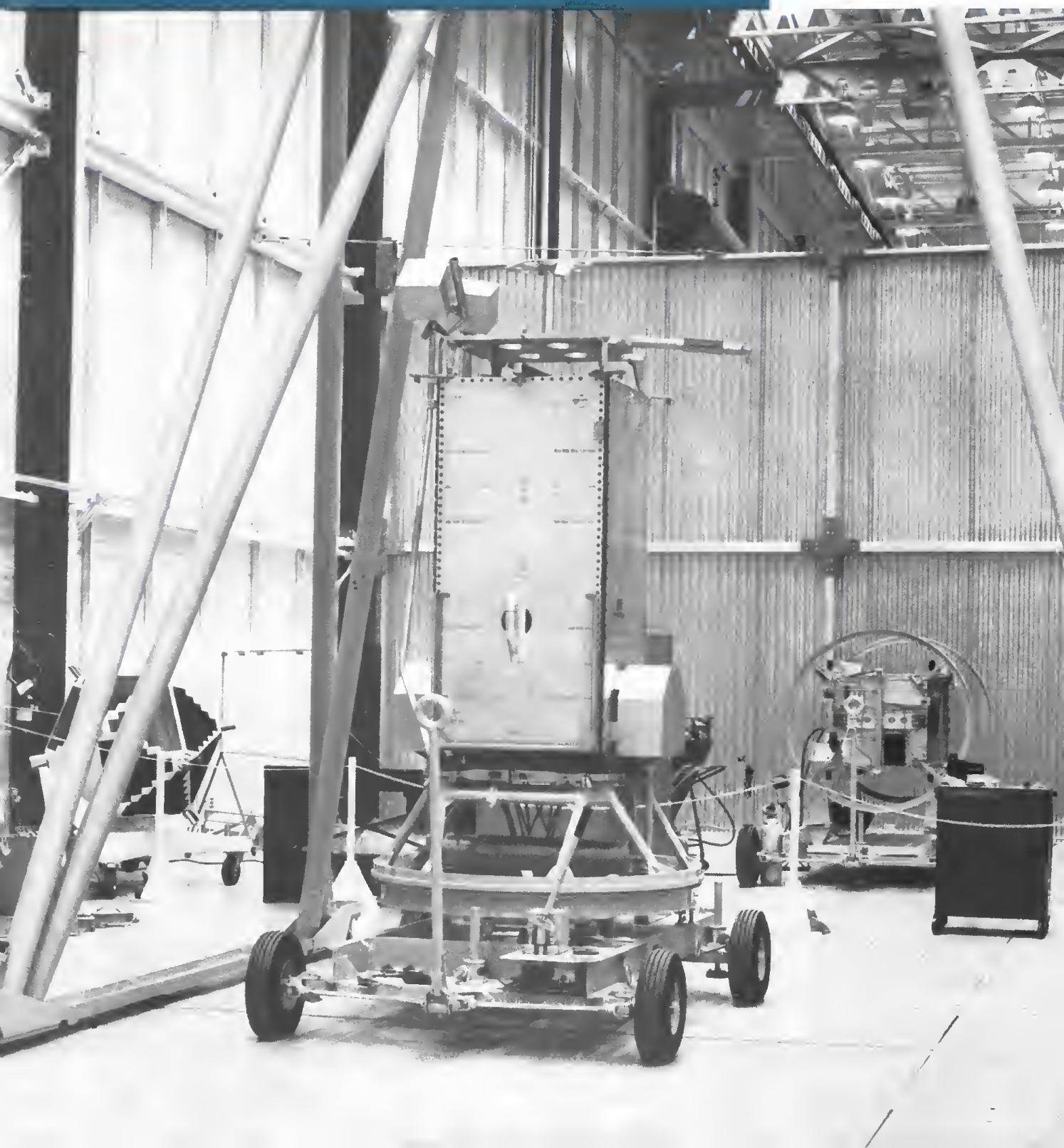
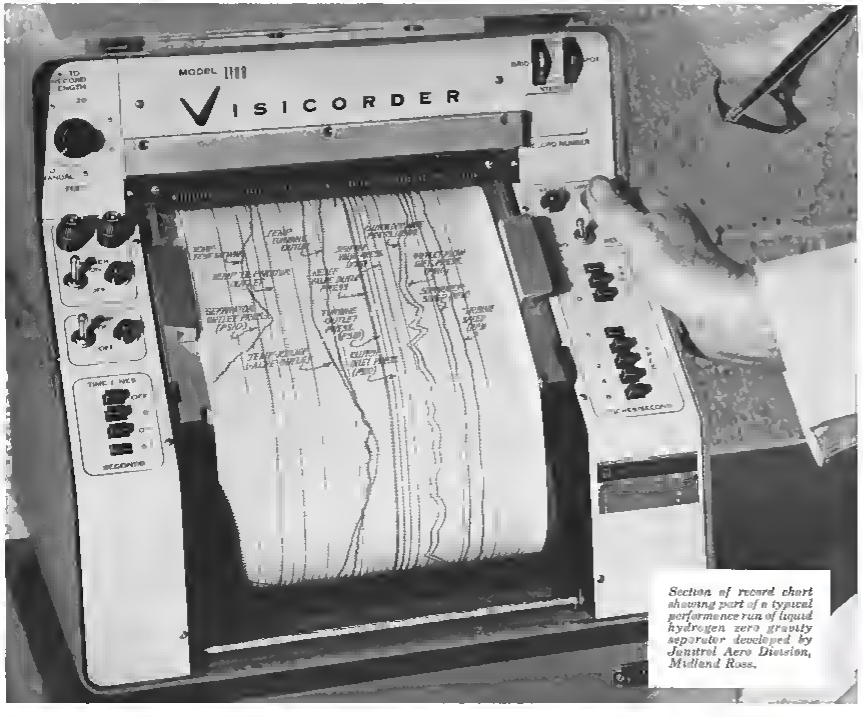
May 27, 1963

SPECIAL REPORT:

F-1 Engine Test Firings

OGO and Vela Hotel





Section of record chart showing part of a typical performance run of liquid hydrogen zero gravity separator developed by Janitrol Aero Division, Midland Ross.

The Honeywell Visicorder Oscillograph tests liquid hydrogen systems in "space"

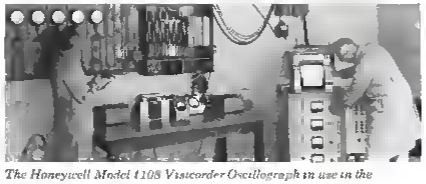
The Janitrol Aero Division of Midland Ross Corporation uses a Model 1108 Honeywell Visicorder Oscillograph to measure and record temperatures and pressures at their new cryogenic test facility at Columbus, Ohio.

In order to simulate conditions as they exist in space, a wide variety of flow rates and pressures must be measured accurately and dependably. The 1108 Visicorder provides Janitrol with direct readout of tests on missile hardware and systems which operate on liquid hydrogen, liquid nitrogen, and other cryogenic fuels.

The new Janitrol facility includes a 500-gallon Dewar, 6' deep and 4' in diameter, that accepts components for static or dynamic test up to this size. Pressures range from 1 psia to 75 psia, and flow rates vary broadly because of the size of the test system.

Honeywell—pioneer in the science of oscillography—offers a wide range of Visicorder Oscillographs to suit your budget and your test requirements. The 36-channel Model 1012 is the most sophisticated, the 6-channel 1406 costs the least per channel. In between are the 8- or 14-channel 906C, the intermediate 24-channel 1108, and the compact 24-channel 1508. Most models record at frequencies from DC to 5000 cps and all have many extra, convenient operating features.

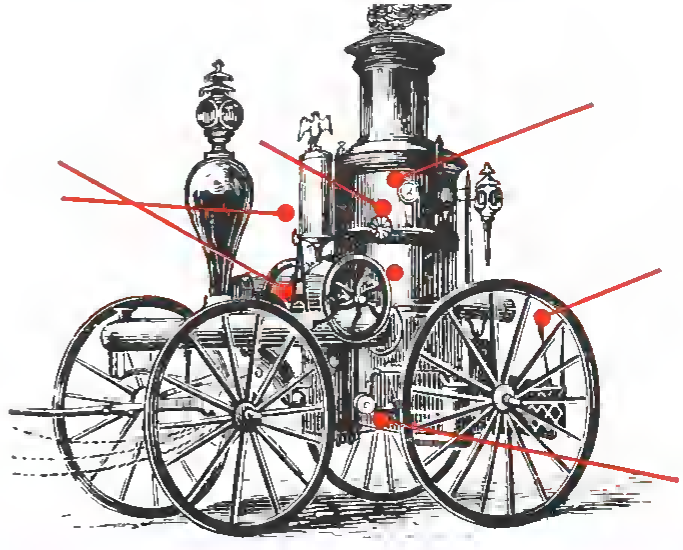
For details, write Minneapolis-Honeywell, Denver Division, 4800 E. Dry Creek Road, Denver 10, Colorado.



The Honeywell Model 1108 Visicorder Oscillograph in use in the Janitrol test room

DATA HANDLING SYSTEMS

Honeywell



FORERUNNER OF REACTION CONTROLS?

Wondering what this ancient pumper has in common with reaction controls for aerospace applications? They're both based on the science of fluid dynamics.

Vickers business for more than 40 years with emphasis on aerospace applications dating back to the early '40s.

Current projects under study or development at Vickers Aerospace Division include: midcourse velocity correction and reentry steering, attitude control systems and components, solid propellant rocket attitude control systems and components and proportional hot gas secondary injection.

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Vickers developments include a bipropellant 55-pound thrust rocket motor (left) and 1-pound thrust bipropellant motor (right). For more details about these and other recent aerospace developments write for Bulletin A-5283 "Harnessing Fluids for Airborne Uses" to: Vickers Incorporated Division, P.O. Box 302, Troy, Michigan.

VICKERS

DIVISION OF SPERRY RAND CORPORATION

AEROSPACE CALENDAR

June 3-5—Symposium on Materials and Processes for Space Power and Primary Propulsion, Society of Aerospace Material and Process Engineers, Bellevue-Stratford Hotel, Philadelphia, Pa.

June 3-5—Spring Lubrication Symposium, American Society of Mechanical Engineers, Hotel Somerset, Boston, Mass.

June 3-11—COSPAR Fourth International Space Science Symposium and Sixth Plenary Meeting, Warsaw, Poland.

June 4-6—17th Annual Convention and Exhibition, Armed Forces Communications & Electronics Assn., Sheraton Park Hotel, Washington, D. C.

June 4-6—Ninth Annual Radar Symposium (Secret), conducted by the University of Michigan at Fort Monmouth, N. J. Sponsors: USA, USN, USAF.

June 4-6—National Electronic Packaging and Production Conference, Coliseum, New York, N. Y.

June 6-7—Symposium on the Exploration of Mars, Denver Hilton Hotel, Denver, Colo. Sponsor: American Astronautical Society. Co-sponsors: American Astronomical Society, American Institute of Biological Sciences, AIAA Rocky Mountain Sections, NASA.

June 7-8—14th National Maintenance & Operations Meeting, Reading Aviation Service, Reading, Pa.

June 7-16—25th French International Air Show, Le Bourget, Paris, France.

June 10-28—Symposium on Lubrication and

(Continued on page 7)

AVIATION WEEK & Space Technology

May 27, 1963

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AEROSPACE CALENDAR

(Continued from page 5)

Wean, University of Houston. For information: Dr. D. Muster, Dept. of Mechanical Engineering, University of Houston, Houston 4, Tex.

June 11-14—Symposium on Plasma Space Science. The Catholic University of America, Washington, D.C., with the support of NASA and Goddard Space Flight Center.

June 12-14—Heat Transfer and Fluid Mechanics Institute. American Institute of Aeronautics and Astronautics, California Institute of Technology, Pasadena.

June 13-15—Great Lakes Navy Research and Development Clinic. Ohio State University, Columbus, Ohio, conducted by the Office of Naval Material.

June 17-20—Summer Meeting. American Institute of Aeronautics and Astronautics (AIAA), Hotel Ambassador, Los Angeles.

June 17-21—Summer General Meeting. Institute of Electrical and Electronics Engineers, Toronto, Canada.

June 18-20—41st Meeting. Aviation Distributors and Manufacturers Assn., Chateau Frontenac, Quebec, Canada.

June 19-21—Fourth Joint Automatic Control Conference. University of Minnesota, Minneapolis, Minn. Sponsors: American Institute of Chemical Engineers, Institute of Electrical and Electronic Engineers, American Society of Mechanical Engineers, Instrument Society of America.

June 20-22—National Meeting. Institute of Navigation, University of Michigan, Ann Arbor, Mich.

June 23-28—66th Annual Meeting. American Society for Testing and Materials, Chalfonte-Haddon Hall, Atlantic City.

June 26-27—10th Annual Symposium on Computers and Data Processing. University of Denver's Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.

June 26-27—Symposium on Dynamic Load Problems—Helicopters and V/STOL. Statler Hilton Hotel, Buffalo, N.Y. Sponsors: Cornell Aeronautical Laboratory, Army Transportation Corp.

June 28-July 3—Second Annual Dorado Fly In. Dorado Beach Hotel, Dorado, P.R.

July 7-11—Seventh National Conference on Aerospace Education. National Aerospace Education Council, Hotel Deauville, Miami Beach, Fla.

July 9-11—International Symposium on Space Telecommunications. Institute of Electrical and Electronic Engineers' Professional Group on Antennas and Propagation, Boulder Laboratories, Boulder, Colo.

July 10-12—Meteorological Support for Aerospace Testing and Operation. American Institute of Aeronautics and Astronautics and American Meteorological Society, Ft. Collins, Colo.

July 23-26—Torpedo Propulsion Conference (Confidential). American Institute of Aeronautics and Astronautics, U.S. Naval Underwater Ordnance Laboratory, Newport, R.I.

July 25-27—1963 Microminiaturization Congress. American Institute for Microminiaturization, Sheraton-Park Hotel, Washington, D.C.

Aug. 4-9—International Conference and Exhibit on Aerospace Support. Institute of

(Continued on page 9)

AEROSPACE CALENDAR

(Continued from page 7)

Electrical and Electronics Engineers/American Society of Mechanical Engineers Park Sheraton Hotel, Washington

Aug 12-14—Guidance and Control Conference American Institute of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Mass.

Aug. 14-16—Fifth Biennial Gas Dynamics Symposium Northwestern University/American Institute of Aeronautics and Astronautics, Evanston, Ill.

Aug. 19-21 — Astrodynamics Conference, American Institute of Aeronautics and Astronautics, Yale University, New Haven

Aug. 20-23—1963 Western Electronic Show and Convention (WESCON) Cow Palace, San Francisco, Calif.

Aug. 26-28—Simulation for Aerospace Flight Conference American Institute of Aeronautics and Astronautics, Deshler-Hilton Hotel, Columbus, Ohio

Aug. 26-28—Conference on Physics of Entry into Planetary Atmospheres American Institute of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 8-11—International Symposium on High Temperature Technology, Asilomar, Calif. Sponsor: Stanford Research Institute

Sept. 8-11—Annual Meeting Air Industries Assn. of Canada, Manoir Richelieu, Murray Bay, Quebec

Sept. 9-11—Seventh National Convention on Military Electronics, Institute of Electrical and Electronics Engineers, Shoreham Hotel, Washington, D. C.

Sept. 9-12—18th Annual Instrument Automation Conference & Exhibit, Instrument Society of America, McCormick Place, Chicago, Ill.

Sept. 10-12—National Symposium on Space Rendezvous, Rescue and Recovery, Edwards AFB, Calif. Sponsors: American Astronautical Society, Air Force Flight Test Center

Sept. 16-18—International Aviation Research and Development Symposium, Atlantic City, N. J. Sponsor: Federal Aviation Agency

Sept. 18-19—1963 Airwork Operations and Maintenance Symposium, Millville, N. J.

Sept. 23-27 — International Telemetering Conference, Savoy Place, London, England. Sponsors: Institution of Electrical Engineers (London), American Institute of Aeronautics and Astronautics, Institute of Electrical and Electronics Engineers, Instrument Society of America

Sept. 25-26—Second Annual Symposium on The Physics of Failure in Electronics, Chicago, Ill. Sponsors: Rome Air Development Center, Armour Research Foundation

Sept. 26-Oct. 1—14th Congress, International Astronautical Federation, Paris

Sept. 30-Oct. 1—Manned Interplanetary Exploration Meeting, American Institute of Aeronautics and Astronautics, Cabana Motor Hotel, Palo Alto, Calif.

Oct. 15-18—Eighth Symposium on Ballistic Missile and Space Technology, Naval Training Center, San Diego, Calif. Sponsors: Air Force Space Systems Div., Air Force Ballistic Systems Div., Aerospace Corp.

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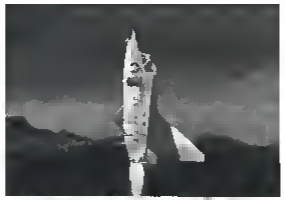
RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIFORNIA



RYAN X-13 VERTIJET, world's first jet VTOL aircraft was developed under Air Force and Navy contracts dating back to 1946. This was the first aircraft to demonstrate feasibility of vertical jet take off with transition to level flight.

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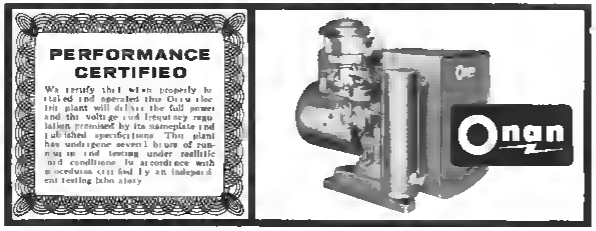
We hope you'll give us an opportunity to talk to you soon about Onan products and R & D capabilities. Write: Government Products Department, 2515 University Ave. S. E., Minneapolis 14, Minnesota.



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Volume 78
Number 21

Aviation Week & Space Technology

May 27, 1963

CONTENTS

COVER: Orbiting Geophysical Observatory (OGO) and Vela Hotel satellite payloads are shown in various stages of construction at Space Technology Laboratories. OGO framework, on trailer in foreground, has solar panels installed. OGO payload at right background is ready for electronics components installation and checkout. Vela Hotel, now known as Program 823, left background, is a nuclear blast detection system (AW May 20, p. 23) and will be injected into orbit from an Agena D spacecraft.

PICTURE CREDITS
Cover—Ralph Turner, Space Technology Laboratories. 22—NASA. 28, 29—U. S. Navy. 37, 48, 49, 51—Aviation Week. 54—Ling-Temco-Vought. 62, 63—General Electric. 65, 67—NASA. 67 (bot.)—General Dynamics/Astronautics. 70, 71—Bell & Royce. 85—Sud Aviation. 88—Cessna. 94—Beech.

The Atlantic Fare Battle

The current battle over North Atlantic airline fares concerns basic issues far more significant than the money immediately at stake. These are:

• **Will international air transport** grow at the rate that the combination of jet equipment and efficient airline management makes possible, or will it be artificially retarded by government edict to the pace of the least efficient operator?

• **Will the U. S. State Dept.** permit U. S. air travelers to reap the dividends that can now be offered by efficient airlines in the form of lower fares, or will it continue to compel these U. S. citizens to pay what is in effect a subsidy, concealed in the tickets they buy, to some inefficient foreign airlines?

International airlines have always been divided into two categories: those who operated primarily as a commercial enterprise and were dedicated to the goal of making a profit, and those who were operated primarily as a flag-flying enterprise based on a substantial and perpetual government subsidy. The advent of jet transports widened the gulf between these two types of international airlines until the present impasse arose. This gulf will get wider and the issue more acute despite whatever temporary patchwork may be used to avert the present crisis.

The stress and strains produced by this divergence have generated a series of international rate crises in the jet age, beginning with the now historic IATA traffic conference of 1958 at Cannes. Most of these crises concerned the degree to which rates should be lowered, and they were eventually compromised without changing the inevitable trend toward lower fares. The current crisis is caused by the determination of Great Britain and its supporters to reverse this trend and raise rates on the North Atlantic.

British Shortcomings

It is a matter of record that the government-owned British Overseas Airways Corp. has experienced only a modicum of success in its North Atlantic operations, caused in part by the failure of the British aircraft industry to produce transports that could compete successfully with U. S. designs, and in part by a financial and operational structure that BOAC Chairman Sir Matthew Slattery described at the end of his first year in office as "bloody crazy."

There are now some 18 international airlines flying the North Atlantic, and under their bilateral agreements with the U. S. nobody challenges their right to tap the U. S. market. But what is challengeable, and we think rightly so, is their demand to operate as inefficiently as they please and pass on a good share of their subsidy requirement to the U. S. air traveler. This is really what the British government is fighting for, and this is what the U. S. Civil Aeronautics Board and Congress are opposing so strongly, despite the State Dept.'s policy of "peace at any price."

CAB Chairman Alan Boyd has been steadfast in his opposition to the British attempt to turn back the clock of airline progress, and we thoroughly agree with his statement that:

"... the passenger is not responsible for the amount of traffic generated by the airlines and should not be required to pay for empty seats." He has also noted that traffic and earnings will continue to improve on the North Atlantic in 1963 and "we are unable to convince ourselves of the wisdom of a fare increase."

It is the U. S. traveller that is being stuck with the largest share of this subsidy through high rates demanded by the British, who as the leader of the fare boost contingent also have taken on the role of champion of corporate inefficiency. U. S. citizens accounted for slightly more than 60% of the two million people who flew the Atlantic in 1962, while U. S. airlines only earned about 36% of the total traffic. In all fairness, we must note that not all foreign carriers are fighting for high rates (see p. 34), and some of them are pressing just as hard as U. S. airlines for a lowering of rates as fast as increasing efficiency and traffic permit.

American Dollar Flow

In addition to the traffic support U. S. citizens provide to foreign airlines, they also deposit abroad a multi-billion dollar annual tourist egg that plays a major role in the prosperous European economy.

The high fare contingent led by the British produced some rather outrageous threats of coercion against U. S. carriers in their so-far successful attempt to turn the rate tide. But we suggest to them that they may have won a Pyrrhic victory. For they will find that the U. S. citizen—no less now than in 1776—is not as supine as his State Dept. Nor are his duly elected representatives in Congress. Already there is a rising tide of indignation on this side of the Atlantic over the British bludgeoning. We predict that it will continue to rise until a new international fare policy is legislated by this government to protect its citizens from the subsidy levied on them by some less efficient foreign airlines. If economic sanctions are to be applied the balance favors the U. S. by a wide margin, if all its officials have the courage exhibited by Mr. Boyd and his vice chairman, Robert Murphy. It is evident that the International Air Transport Assn. is nearing the end of its road as the prime formulator of international air fare policy, and that this role must be taken over by the governments themselves. IATA can continue its useful function in translating this policy into tariffs and operating its international clearing house and other useful service functions.

—Robert Hotz

WHO'S WHERE

In the Front Office

Thomas F Dixon a vice president North American Aviation Inc El Segundo Calif Mr Dixon is assistant to President J L Atwood

George E Stoll, president, and **Charles F Heitman, Jr.**, executive vice president of The Sheffield Corp Dayton, Ohio elected chairman and vice chairman respectively of the board Mr Stoll succeeds **Louis Polk** who continues as a director and also a vice president and director of Bendix

Milford B Moore, president and general manager Technology Instrument Corp of California Newbury Park Calif a subsidiary of Bourns Instrument Corp

Dr Anselm Franz vice president and general manager gas turbines Avco Corp Lycoming Div Stratford Conn and **Dr Heinrich Adolstedt** vice president gas turbines operations

Dr H J Smead, vice president Telidyne Inc Hawthorne Calif., and general manager of Teledyne's Electronic Systems Div

Uhrn B Dalgaard, regional vice president Europe the Middle East Africa and India American Airlines Inc with headquarters in London England

Brig Gen George R Stanley (USAF ret) a director AirKaman a subsidiary of Kaman Aircraft Corp Bloomfield Conn

William E Aebon president Ideal Aerosmith Div of Royal Industries Inc Cheyenne Wyo

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Nevin F Decker assistant to the president Hamilton Standard Div of United Aircraft Corp Windsor Locks Conn

D C Johnson a divisional director of S Smith & Sons (England) Ltd and a member of the Aviation Div's board

Jack Kirschbaum executive vice president Alpha Wire Corp New York N Y

Paul F Brabazon, vice president Avemco Finance Corp Silver Spring Md Also **Harry G Kneb**, Philadelphia investment banker elected a director of Avemco

D W Powers secretary director and formerly vice president-engineering Rockwell Corp New York N Y now in charge of the company's expansion and diversification program **V L Carbonaro** appointed director of engineering to replace Mr Powers

Edward R Cain vice president Sales and Service Divisions Aero Commander Inc Bethany Okla

Henry E Hockheimer, a vice president Philco Corp Philadelphia Pa he continues as general manager of the Communications and Electronics Div

Daniel S Karp, vice president and general manager REI Dynamics Corp Mineola N Y and **A Richard Willis Jr** executive vice president

Vice President Ronald D Cone, appointed director of engineering for California Computer Products Inc Anaheim Calif

John P Brock, executive assistant to the vice president marketing Trans World Airlines Inc

(Continued on page 102)

INDUSTRY OBSERVER

► Studies of extended Mercury mission times have shown that a flight of at least 100-hr. duration could be made by adding 300 lb. of consumables to the basic McDonnell-built capsule. Most of the added weight would be attributable to batteries. But chances are slim that National Aeronautics and Space Administration will decide to make another Mercury flight.

► Navy anti-submarine warfare experts see very little growth potential in the magnetic anomaly detection (MAD) system currently used to confirm the presence of a submerged submarine. Although the system is accurate, it is extremely limited in effective range. Current types of deep-diving submarines should be able to run below its useful detection depth. Long-range sonar remains as the major and most effective submarine detection system.

► Techniques for the application of lasers to an optical Doppler navigation system will be studied in a research and development program planned by USAF's Aeronautical Systems Div. ASD is seeking qualified sources for study of suitable laser modulation and heterodyning techniques and laser frequency control using Zeeman magnetic-field techniques.

► Russians continue to ask for a revival of dirigible construction in articles published in Izvestia, one of the official government newspapers. Design bureau has been formed in Leningrad to "gather information on building dirigibles." Izvestia points out that the lighter-than-air vehicles could be used for carrying passengers and bulky cargo, for forest-fire fighting, astronomical and meteorological observation, aerial photography and ice-pack surveys.

► Sikorsky SH-3A anti-submarine warfare helicopters will be fitted with auxiliary flotation bags stowed in the sponsons and inflated automatically to help stabilize the aircraft after an open-sea landing. Navy experience with the helicopter has classed such landings as "emergency only" procedures because of the danger that the SH-3A will roll over in 3- to 5-ft. waves. Current procedure is to keep lift on the rotors to stabilize the aircraft. If both engines have failed and the helicopter has been landed deadstick, it can capsize in 30 to 45 sec.

► Proposal evaluation in Advanced Research Projects Agency's high-acceleration booster experiment (HIBEX) is expected to be completed by May 30. Program requirements probably will call for 500g acceleration and a propellant burning rate of about 2 in./sec. This compares with slightly higher burning rates required for a composite-propellant combination as backup for the double-base propulsion system already selected for the Sprint anti-missile missile. Very large solid-propellant booster motors now under development or in feasibility phases will have burning rates near 0.6 in./sec.

► NASA's Lewis Research Center will support industry investigation of requirements for materials for space electrical power systems. Tasks will include compilation of material properties based on state-of-the-art experimental determination of required additional critical properties for selected materials, development of fabrication techniques and special environmental testing which will include radiation damage studies. Industry bids for the work were submitted Apr. 30.

► Industry proposals to extend Apollo mission capability by using high-energy propellants and advanced systems designs are being evaluated at NASA's Manned Spacecraft Center. Two study phases are contemplated. First will include propellant combinations and systems capable of being operational by 1970; second would be a similar task with a 1975 date.

► Thiokol solid-propellant rocket motor for the USAF Boeing X-20 (Dyna-Soar) is being readied for its Preliminary Flight Rating Test (PFRT). Loaded motor weighs about 3,500 lb. It is an on-board system, never jettisoned, and will be used in three roles. In early tests it will accelerate the Dyna-Soar away from its B-52 mother plane. In later rocket-boosted tests it will be the abort system for the manned vehicle. Ultimately it will serve as a 1st stage for powered flight.

Washington Roundup

The Peekaboo Curtain

Government's now-you-see-it, now-you-don't approach to the reporting of Russian space failures is finally getting a thorough going-over in Congress. The House Government Information Subcommittee last week sharply criticized National Aeronautics and Space Administration for acquiescing to Defense Dept.'s wishes by omitting Soviet launch information from its Satellite Situation Report (AW May 6, p. 21). It questioned Dr. George L. Simpson, Jr., on why he needs 175 employees in various information jobs in headquarters alone if he can't talk about Soviet shots, and even questioned his suitability to serve as assistant administrator for technology utilization and policy planning. Simpson is a sociologist.

Subcommittee will call NASA Administrator James E. Webb and Deputy Administrator Hugh L. Dryden and Assistant Secretary of Defense for Public Affairs Arthur Sylvester to explore the question further. They are particularly interested in how Webb was able to report very quickly and in great detail last September on six Russian failures, and why—if NASA can get this kind of information—it doesn't pass it on to the public regularly.

Airlines Get the Boyd

One of the first public criticisms of the airlines by a Civil Aeronautics Board member on a subject not directly related to tariffs came last week from CAB Chairman Alan S. Boyd. Testifying on the North Atlantic fare fight (see p. 34), Boyd said: "I think one of the most short-sighted arguments that our carriers have ever made was to attempt to get capacity [control] legislation. I think they are just asking to have their own throats cut. . . . They have sought to develop a double standard and I have no sympathy with their positions whatsoever. They want to be able to go anywhere they want to go and they want to stand up and say to everybody else competing with them, 'no, you can't come in here.'"

NASA last week settled the question of whether to hire one or a number of contractors for housekeeping services at its Merritt Island, Fla., launch complex by breaking the work into four tasks—communications, base services, launch support services and administrative and management services. Thirty-five companies were invited to a conference on the communications contract May 27 at the Launch Operations Center at Cape Canaveral. This will be awarded July 15 and competitions for the other categories will begin about that time.

Program Definition Plan

Pentagon is about to require "program definition" phases for a broader range of advanced technology projects under a directive to be issued next month. It will spell out the types and dollar size of contracts to be covered. Only three major programs have used this phase so far—Titan 3, mobile medium-range ballistic missile and the Lance battlefield missile. Dr. Harold Brown, defense director of research and engineering, told the House Military Operations Subcommittee last week that the purpose of a definition phase is to provide mutual understanding between government and contractor on "what is wanted, how to proceed and what it will cost in money and time."

Legislation to keep the Arms Control and Disarmament Agency alive probably will be passed by Congress, but it is receiving a very low priority. Under present law there is a $10 million ceiling on its budget. Of this, $8.5 million already has been appropriated for Fiscal 1962 and Fiscal 1963, and the President has asked $15 million for Fiscal 1964. Senate Foreign Relations Committee has held hearings on a bill to lift the ceiling but has taken no action. House has not even scheduled hearings.

Boeing Reorganization

Boeing Co., whose mainstay in recent years has been Air Force bombers, last week combined its Military Aircraft Systems and Transport divisions into the Airplane Div. John O. Yeasting, vice president and general manager of the Transport Div., will hold the same titles in the new division and will be responsible for aircraft operations at Seattle and Renton, Wash., and Wichita, Kan. The company said the move would not affect its ability to build TFX prototypes if the current Senate investigation (see p. 32) should result in a build-and-fly competition with General Dynamics-Grumman.

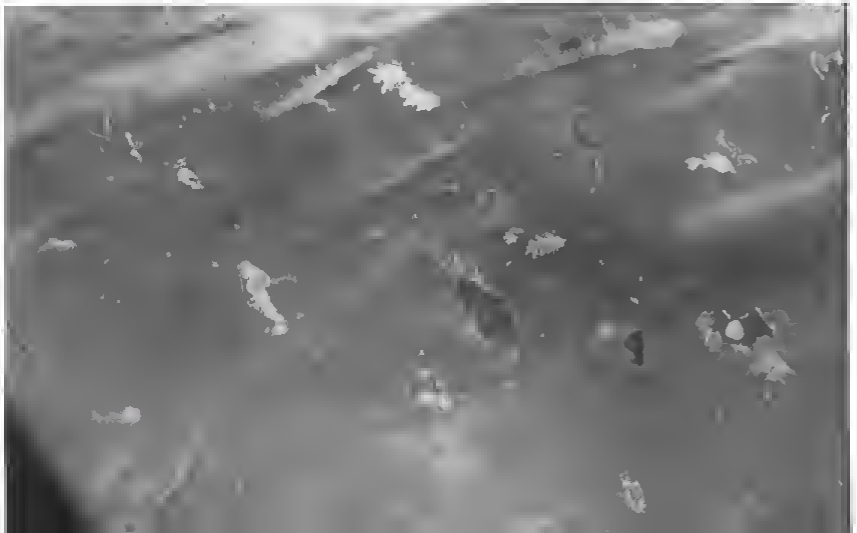
Navy, whose first study of nuclear-powered carriers was rejected (AW May 6, p. 35), has now assigned the task to Rear Adm. T. F. Connolly, director of the strike warfare division under the deputy chief of naval operations for operations.

Air Force and Navy, still arguing over definitions of tactical air missions (AW May 6, p. 35), went through a head-knocking session last week at the hands of Dr. John L. McLucas, deputy director of defense research and engineering for tactical warfare systems. Result: a standard set of guidelines for tactical war gaming and flight testing.

Joint Congressional Atomic Energy Committee will begin open hearings June 3 on fallout released by U.S. and Soviet tests last year, fallout now in the atmosphere and programs to develop radiation countermeasures.

—Washington Staff

VIEW OBTAINABLE ONLY FROM SPACE of the vast reaches of the Himalaya mountains (above) was photographed by Maj Gordon Cooper during his MA-9 flight with a 70 mm hand-held camera Lakes, some ice-covered, rivers, and other landscape features are visible (below) on a plateau near the Himalayas probably the Tibetan plateau



NASA Weighs MA-10; 6-Day Flight Urged

Decision due this week; open-end mission could replace two early Gemini efforts and save six months.

By Edward H Kolcum

Washington—Key National Aeronautics and Space Administration officials have agreed under pressure from within the agency to defer until this week a final decision on another Mercury flight The added flight is now being proposed as an open-end mission that would last as long as six days, and possibly gain six months in the manned flight program by eliminating at least two short-duration Gemini flights

President Kennedy said at his May 22 news conference that the Mercury astronauts, who strongly favor a Mercury Atlas-10 mission, discussed the flight with him He apparently was impressed with their arguments He said he will talk to NASA Administrator James E Webb about it this week, but will not interfere with the decision

Both Webb and Brainerd Holmes, director of manned space flight programs, had decided by May 20 that USAF Maj Gordon Cooper's 22-orbit Mercury Atlas 9 mission (see p 25) effectively closed out the Mercury program, and the manned flight effort would now go to Gemini and Apollo

But on May 21, after the Mercury astronaut team and Manned Spacecraft Center officials had arrived here for Cooper's reception (see p 24) and discussed the MA-10 with them, both Webb and Holmes were persuaded to withhold their decision until the preliminary assessment of Cooper's data is completed Final decision on MA-10 could come as early as May 28

Webb and other NASA decision makers have held firmly to the position that MA-10 will be scheduled only if there was a failure or distinct gap in data returned from MA-9 (AW May 13, p 34) Webb said shortly after the MA-9 flight that a preliminary look indicated there is no gap in data returned that it has more than answered all the questions it was supposed to

Webb's reasoning is that the future of the U S space program depends upon the Saturn C-5 launch vehicle and the Apollo spacecraft system He feels that another Mercury flight would drain money, time and manpower from Saturn and Apollo

Six of the seven original Mercury astronauts, including Cooper, had the opportunity to talk to President Kennedy the night of May 21 at a private party he had for them Marine Lt Col John H Glenn was in Japan At his conference the next day, the President said in response to a question, "I think they [the astronauts] feel it [MA-10] is worthwhile I haven't discussed it with Mr Webb NASA should make the judgment and will make the judgment, and I would not intervene, but they do feel that a flight is useful, and that the experience of Maj Cooper has indicated that the time between the last Mercury flight and the new Gemini flight, which is a period of almost 18 months, they feel may represent a gap which could be filled very usefully by another Mercury flight

"This will be a matter which I think they [the astronauts] are going to be talking about this week with Mr Webb and which I would discuss with them next week, but the final judgment must be NASA's"

In his talk before the joint session of Congress, Cooper had intended to include reference to the desirability of MA-10 as a means of exploiting what has been learned from the earlier ballistic and orbital Mercury flights But he omitted this inadvertently because he was excited an official said

Manned Spacecraft Center was split over the need for another Mercury mission until after Cooper's flight At that time top echelon solidified its position and began pressing for MA-10 The center has developed a series of reasons for the flight The most meaningful is that it would allow NASA to skip the one- and three-day Gemini manned flights thereby cutting six months from the Gemini program and allowing 7- and 14-day flights as soon as systems are considered qualified

The proposed MA-10 mission is called open end because it would be designed to repeat Cooper's 22 orbits and then to continue as long as consumables lasted and the pilot remained in good condition Studies completed immediately before MA-9 indicate the mission could last as long as 96 orbits or 144 hr

A 72-hr mission proponents feel, could be flown in September An open-end flight would require one more month of preparation The proponents further argue that there is a possibility that a six-day flight in October represents an opportunity, even though it may be slim, for showing U S capability at this time surpasses Russia's

There is considerable speculation that Russia has the capability for a 12-day manned mission, and is long overdue in trying manned flight of this duration

Although Cooper's MA-9 flight is considered to be the best Mercury mission flown to date Manned Spacecraft Center feels the flight uncovered a number of problems which should be solved before extended duration Gemini missions are attempted They consider that there are effective arguments for another Mercury flight, such as

- **Food handling and eating** Cooper ate only 400-500 calories of food, mostly dessert during his flight He had difficulty in reconstituting the dehydrated food Long-duration flights require considerably more calorie intake and a more balanced diet
- **Waste disposal** and water balance studies Mercury officials are unsatisfied with the system for collecting urine samples and the way in which the condensate collection system operated
- **Power consumption** There is a fear that there was an exceptionally high drain on the battery system from a short circuit in the automatic sequencer, which would invalidate the reading on battery power remaining at landing
- **Weightlessness-effects analysis** Physicians would like more data on the metabolic processes after long duration space flight Cooper experienced about 15 sec of dizziness after he emerged from the capsule, but returned to normal after a few steps
- **Operational readiness** Manned Spacecraft Center fears the effects of 18 months idleness on the pre-launch, launch, medical operations and mission control teams

Against these arguments is the position expressed by Webb—that NASA should devote its energies talent and money to Gemini Saturn and Apollo He feels that these programs are critical not only to manned lunar landing, but also to space station lunar exploration and planetary flights, since basic hardware for advanced missions will be flight tested and qualified by Apollo

Cosmos 17 Launched

Moscow—Seventeenth satellite in the Cosmos series was launched May 22 by Soviet Russia into an orbit with an inclination to the equator of 49 3 deg, apogee of 492 5 mi perigee of 162 5 mi, and period of 94 82 min It was the fifth Cosmos satellite launch announced this year—the second in a similar inclination

NASA Still Faces Budget Cuts Despite Successful MA-9 Flight

By Alfred P. Ahlbrando

Washington—Brilliant success of the MA-9 flight and the triumphal visit of Air Force Maj. L. Gordon Cooper to Congress has not changed the prospect of a $200 million cut in the $5.7 billion National Aeronautics and Space Administration is asking for Fiscal 1964.

Members of House space subcommittees now completing their work on the NASA budget said the emotional response to Cooper's address to a joint session of Congress last week would not influence their decisions.

The flight improved the attitude of Congress toward the manned flight program in a general way," said Rep. Emilio Q. Daddario (D.-Conn.), a member of the manned space flight subcommittee, "but it didn't change our thinking. There will be cuts."

Rep. Olin Teague (D.-Tex.), chairman of the manned space flight subcommittee, said reductions probably would be in the form of deferred construction.

Recommended cut in the manned flight budget is expected to total about $115 million, and reductions in funds for space science, advanced research and tracking about $85 million.

Over the last two years, congressional support for manned space flight has alternated between wild enthusiasm and uncertainty and skepticism. Favorable response to NASA's budget requests has depended largely on the timing of U.S. and Russian manned space flights.

In the six months between Walter Schirra's six-orbit flight and Cooper's 34-hour mission, congressional misgivings over spending $20-$40 billion on the Apollo manned lunar landing program increased (AW Apr. 8, p. 32).

Maj. Cooper's flight provided President Kennedy, NASA officials and other proponents of the space program with the opportunity to make a concerted public relations effort on behalf of the manned flight program. At the White House reception for Cooper, the President said:

"... however extraordinary computers may be, man is still the most extraordinary computer of all. His judgment, his nerve and the lessons he can learn from experience still make him unique and therefore make manned flight necessary and not merely that of satellites.

"I hope that we will be encouraged to continue with this program. I know that a good many people say, why go to the moon?' just as many people said to Lindbergh, 'why go to Paris?' Lindbergh said, 'It's not so much a matter of logic as it is a feeling.'

I think that the United States has committed itself to this great adventure in the sixties. I think before the end of the sixties we will see a man on the moon—an American—and ... it's not merely that we're interested in making this particular journey but we are interested in demonstrating a dominance of this new sea.

Cooper's address at the joint session of Congress included a subtle reminder to the members that manned space flight is popular with the voters.

"I think of all things I'm constantly amazed at, is that of the public's response to this program," Maj. Cooper said. "I think it's tremendously impressive ... examples of this are the parades that we've had after every flight ... [which] show that Americans want to express their feelings and confidence."

This public response included the estimated 250,000 persons who stood 10 deep along Washington's streets to catch a glimpse of the nation's newest space hero and an estimated 2 million who lined the route of a New York ticker tape parade.

Maj. Cooper's flight and the public response that followed put an end, at least for a time, to demands in Congress and elsewhere for crippling cuts of up to $800 million in the space budget and a stretch-out or elimination of Project Apollo. In the months before the flight, there were almost daily attacks on the Apollo program in the House and Senate. Since the MA-9 launch, there has not been a single speech against the manned lunar landing project.

Although Maj. Cooper's flight gave the manned flight program a lift, the presence of the astronauts in Washington and their personal appeal for another Mercury flight (see p. 23) has not had much effect on Congress.

"I'd kind of like to see one," said Rep. Teague, "but I think the decision should be made on the basis of what another Mercury flight would do to the Gemini schedule."

Maj. Cooper and several other members of the Project Mercury team received NASA awards at the White House ceremony for their part in the MA-9 flight. Maj. Cooper received NASA's Distinguished Service Medal, the agency's highest award. NASA's outstanding leadership medal was presented to G. Merritt Preston, manager of Mercury operations at the Launch Operations Center for checkout and preparation of the spacecraft. Floyd L. Thompson, director of the Langley Research Center, for directing early work on Project Mercury. Kenneth S. Kleinknecht, manager of the Project Mercury Office, for directing development of the Mercury capsule for long duration flight. Christopher C. Kraft, director of Mercury Flight Operations, for flight planning and operations, and Maj. Gen. Leighton I. Davis, commander of the Air Force Missile Test Center, Cape Canaveral, for Defense Dept. support of Project Mercury.

NASA group achievement awards were presented to the Defense Dept. recovery forces for their efficient handling of recovery duties and to the Air Force Space Systems Div. for managing development and launching of the Atlas rocket.

Soviets Lose Mars Probe Contact

Moscow—Soviet Union has admitted that radio contact with its Mars I probe was lost Mar. 21 and that attempts to re-establish contact have failed.

Mars I was launched last Nov. 1 but because of the sketchy information on its progress, there has been widespread speculation that an attempt late last year to fire midcourse correction motors was not successful (AW Apr. 15, p. 39).

USSR issued a report on Mar. 16 claiming a communications record for the payload (AW Mar. 25, p. 26), but this was the last report until May 16. The Soviet news agency Tass said the difficulty appears to be that the probe is oriented so that the antennas no longer are pointed toward earth. Tass said the probe is to reach the vicinity of Mars about June 19 but gave no estimate of the distance by which it will miss the planet.

A total of 61 communication periods were held with the probe and more than 3,000 signals were sent to it from earth, Tass said. Scientific measurements included:

- Intensity of cosmic rays near earth and in space has almost doubled since 1959. The probe also confirmed the existence and magnitude of radiation zones around the earth.
- Solar wind and magnetism were detected in deep space. Magnetic field intensity of 3.4 gammas was measured, and this intensity reached 6.9 gammas several times.
- Probe encountered a Taurids meteor shower at altitudes of 3,700 to 25,000 mi. above the earth, recording one strike every two minutes for an unspecified period. When the payload was 12-24 million mi. from earth, it encountered another unidentified meteor shower with a density about the same as the Taurids shower.

Cooper's Precise Piloting of Faith 7 Cited

By George Alexander

Cape Canaveral—USAF Maj. Gordon Cooper's 22-orbit Mercury-Atlas 9 mission was flown so precisely that the pilot did not omit a single item on his checklist, project officials said at the first public postflight briefing here.

The briefing included Cooper's own summary report on the flight of his Faith 7 capsule (AW May 20, p. 26). Dr. Robert C. Seamans, Jr., associate director of the National Aeronautics and Space Administration said he very much doubts "that we're going to find an astronaut who's going to improve on the performance of Gordon Cooper."

Late last week, NASA and McDonnell engineers had not pinpointed the cause of the problems experienced by Cooper just before re-entry, nor were they certain that the two—the sudden turning on of the 0.05-g panel light and the failure of two inverters—were interconnected.

Inverters had been removed from the Faith 7 capsule by last Wednesday and, in a series of laboratory tests, they operated normally and met acceptance checks.

The trouble is believed to be centered in the amp cal [amplifier calibration], a logic circuit which converts the output signals of different spacecraft sensors, such as gyros and infrared horizon scanners, into firing commands for the thrusters of the attitude control system. Both the inverters and the 0.05-g panel light are connected to different sides of this electronic package.

Immediately after re-entry, Cooper reported that he had several days' supply of breathing oxygen left in his primary and secondary tanks and about 50% of the hydrogen peroxide control fuel supply in both the manual and automatic systems. Fuel was jettisoned prior to landing.

Booster Praised

Prompting himself with a step-by-step record made during the flight, Cooper praised the performance of his General Dynamics/Astronautics Atlas 130-D booster and said he was surprised that boost flight was not rougher. He said he experienced less vibration in the region of greatest dynamic pressure than he expected, said booster engine cut-off was precise and sustainer engine performance was "very, very smooth," and said he could detect no gimbaling of the engine during the sustainer phase of the flight.

Cooper said he found it important to have the first orbit "not too cluttered up with things to do. ... It was a strange environment. I think it takes a short number of minutes to collect one's wits to get the flight plan organized to really get squared away and to start into a fairly intensive flight plan."

On the night side of his first orbit, Cooper saw the night airglow layer seen by previous Mercury pilots. "There is a band of clear sky between the earth and the layer," and then a band 5 to 8 deg. on above this, where the stars were dim and the lesser magnitude [stars] disappeared as they passed behind [the layer]," he said.

During this time, he also saw Astronaut John Glenn's "fireflies" and, like Astronaut Scott Carpenter, identified them as droplets from the exhaust of the attitude control system thrusters.

Cooper went into drift flight as he began the second orbit. "I found this was a very pleasant mode of flight," he said, "very relaxing, no problems at all on worrying or wondering what your attitude was."

Fly-by-wire Mode

About 3 hr. 25 min. into the flight, Cooper shifted from the automatic mode to the fly-by-wire mode, dropped his pitch angle to 20 deg. and deployed a 5.75-in.-dia. flashing light sphere, which was ejected from its storage tube at the base of the spacecraft by a spring and piston.

The sphere was ejected at an angle of 92 deg. from the flight path with a velocity of 10 fps. faster than that of the capsule. It went into an adjacent orbit.

Cooper said he turned his capsule so that the small end faced the direction of flight and "I tried and tried and tried to see the flashing light, to no success" during the first night pass after deployment. This was early in the third orbit.

Nearly two hours later, Cooper said, "I observed this light coming up from below me. ... I thought someone was launching something out in front of me. ... [that is] what it really looked like at first. ... [it] gradually rose up and as I watched it, I finally saw that little rascal strobing."

After observing the sphere's two xenon lamps, which pulsed every 100 microsec. with a peak intensity of 60,000 watts, Cooper vawed the capsule away for about 15 min., then slowly brought it back to see if he could reacquire the light. He found it toward the end of the night side of the fourth orbit and saw it again during the night side of the fifth orbit.

Going into the fifth orbit, Cooper turned off the cabin fan and coolant system to see "if we actually need to utilize all this coolant quantity throughout flight when you're powered down [in drifting flight]. The temperatures remained very reasonable in the cockpit and we left the coolant flow and cabin fan off until just prior to re-entry, and we powered up, cooling it down very slightly." He concluded that prolonged flight could be sustained without cabin cooling.

Water Separator

During the fifth orbit, Cooper experimented with a new water separator device attached to his space suit at the gas inlet valve. This was added to the suit coolant circuit, downstream of the regular water separator. Both units are designed to trap condensate water—perspiration and breath moisture—before the recycled oxygen is sent back into the suit. The device consists of a clamp and a sponge, and at periodic intervals Cooper squeezed the clamp to wring out the saturated sponge. Water thus drawn off was pumped into a tank.

However, Cooper said the needle of the syringe used to transfer water from the suit separator to the tank broke after about 12 hr. of flight. The astronaut spent a considerable portion of the flight with moist gas passing over his body, and doctors said that during post-flight examination on May 16, his skin looked like that of someone who had been immersed in water for too long.

Because of the broken needle and a leaky threader valve on the drinking water tank, some water spilled in the cabin. Cooper said he mopped it up as best he could with a handkerchief. He said he doubted if this water could have caused his later electrical problems with the retro-fire sequencer and the inverters. All instruments and lines are designed to be water-proof.

The pilot also said he had a problem transferring urine samples into separate, time-correlated collection bags. He said he "pumped madly on the pumping system to transfer this [sample] out into various bags." He suggested that larger fittings be used on future flights. "It took approximately half an orbit to pump one sample out," Cooper said.

Early in the sixth orbit, Cooper pitched the capsule down to observe a three-million candlepower ground light experiment at Bloemfontein, South Africa. "I saw it and I saw the town it

B-52, B-47 Modifications to Cost $2.4 Billion

Washington—Intensive extended use of the Boeing B-47 and B-52 bombers is requiring a modification program expected to cost a total of about $2.4 billion, Air Force has told the House Defense Appropriations Subcommittee

B-47 modifications are expected to total $792.1 million through Fiscal 1963. Another $5.4 million will be spent through Fiscal 1965, for a total of $797.5 million, Air Force witnesses said

The last B-47 was delivered to Air Force in February, 1957. All told, 2,041 B-47s and RB-47s were procured. Active B-47 inventory by the end of February, 1963, was 1,221 aircraft. The B-47 is slated to be phased out completely in Fiscal 1966

To date about $400 million has been spent to modify B-52s. Another $1.2 billion will be spent between now and Fiscal 1966, according to Lt. Col. George Rhodes of the USAF maintenance engineering directorate. The last B-52 was delivered to the Air Force in October, 1962. All told, 744 B-52s were procured and 630 of them are in the operational inventory. According to recently released testimony, Maj. Gen. Robert J. Friedman, USAF deputy chief of staff for programs and requirements, said on Mar. 20 that "approximately 15" B-52s have crashed compared with 76 B-47s

was in," he said. He also thought the photometer he was to experiment with was not "operationally suited" because the speed of the capsule takes the pilot over too many varying light areas in too short a time for accurate measurements.

Cooper entered his rest period in the ninth orbit. He estimated that he slept a total of 5 to 6.5 hrs. in increments of 30 to 60 min. because he was experiencing difficulties with the suit coolant system and had to make periodic adjustments.

At one time, Cooper said, he awoke and found his arms dangling "out in front of me." The second Soviet orbital pilot, Gherman Titov, also reported finding his arms like this after sleep. Cooper said this discovery was "distracting, particularly because there are a lot of switches up there [on the instrument panel before him]." Concerned that he might accidentally trip a switch in his sleep, he placed his hands behind his head and hooked his thumbs inside his helmet restraint straps.

At about 29 hr. into the flight, Cooper said, he turned the three-position panel control light switch from "off" to "dim." As he did, the 0.05g light showed green on the automatic sequencer. Whether current was flowing to this one indicator during the time the master panel switch was off or whether the current flowed when the panel switch was thrown to "dim" was not clear at first.

"I thought maybe at first I'd just ignore it," Cooper said, "but I decided that maybe I'd better not." The 0.05g indicator is the ninth panel light in a vertical stack of 14 lights. It normally is triggered by an accelerometer which senses the beginning of re-entry and commands the automatic stabilization control system (ASCS) to begin a constant 12-deg./sec. stabilizing roll. The light is only an indicator and does not command any function.

The pilot said he turned off a few switches connected to this automatic re-entry circuitry and "then proceeded to sit back and try to figure out just what had happened in our amp-cal circuit."

After discussion with Mercury control, it was determined that the automatic sequencer circuitry upstream of the 0.05g switch could not be relied upon to issue the correct commands to ASCS system for retro functions. This circuitry would have commanded the Faith 7 capsule to assume the proper attitude for firing of the three solid propellant retro-rockets and then the firing and jettisoning of the spent motors.

Using the fly-by-wire mode, Cooper established the correct retro attitude. But when, at 31 hr. 29 min. of flight, he powered up the ASCS electrical bus on its main 250-v-amp inverter, which converts the direct current flow of the batteries into alternating current, it powered up normally. He then checked the temperatures of the other two inverters—a 150-v-amp unit used for the suit and cabin fans and a second 250-v-amp unit which could be used as a standby for either fans or control system. His ammeter pulsed several times and then the panel light indicating that the standby inverter was now operating turned green.

Cooper said he knew the light reading was erroneous, because he could see that the control switch to the standby inverter was "off." He then noticed that the voltmeter reading on the main inverter, which was "on," began to peg toward 150 v.—its normal output is 115 v. at 400 cps.—and so he turned it off. Bringing in the standby inverter, he discovered that it would not start. "So we decided we would re-enter completely without the autopilot," Cooper said.

Of the two control modes available to Cooper—fly-by-wire and manual proportional—the former operates directly on d-e pulses to the control solenoids on the thrusters and the latter through mechanical linkage to the thrusters. Cooper decided to bring both on-stream simultaneously for two reasons—one, if the malfunctioning inverters caused a short circuit in the entire MA-9 electrical system during re-entry when g-loads were high, he would still have command of one control system without trying to reach the instrument panel and, two, both systems operating together gave him higher thrust levels—48, 12 and 2 lb. compared with 24, 6 and 1—with smaller stick movements.

"I found," Cooper said, "that re-entry was easier through the first portion than what we had been practicing on the procedures trainer." As he held re-entry attitude, the spacecraft felt as if it wanted to start re-entering. "It got a little mushy on the controls, started nosing in, trying to pitch up as the heat shield nosed down for re-entry," Cooper said. He started his steady roll rate at this point.

"Very shortly thereafter," he said, "I noted a lot of burning particles coming past and considerable heat on the outside—one retrostrap came flying over and sat there right in front of the window. It proceeded to get warmer and got red hot, then white hot and finally broke into several pieces and floated away, burning."

He said he saw the fireball created by the high velocity spacecraft slamming into the denser atmosphere but that re-entry g-loads were not disturbing. "I know we had conjectured as to whether prolonged periods of weightlessness, whether re-entry would be any real problem," the pilot said. "I don't feel that it is any different from what we have done on the centrifuge."

Cooper said that impact in the Pacific Ocean was "easier than anticipated." His craft struck water "in a bit of a swing" and rolled over, but righted itself immediately.

During flight, Cooper said, he could see individual roads and rivers. "I saw some little villages and I noted, where houses were scattered out, I could see individual houses. I saw also, about this time, some trucks on the roads and not too very long after that, a train—with smoke coming out of it—going down a track." He also said he saw a boat on a river and the wake it created.

Cooper said he ate and drank on several occasions during the flight, but that he didn't have too much of an appetite. He did eat one entire box of cubed food, but likened these cubes to dessert, which he said can become tiring fast. He said he was unable to get water into one package of dehydrated food and was thus unable to eat that.

"What would it have been had you managed to get water into it?" Cooper was asked. "Pot roast," he said, holding up a plastic bag containing the dried meat.

NATO Shaping Inter-allied Force With Air, Sea Nuclear Capability

By Donald E. Fink

Ottawa, Canada—North Atlantic Treaty Organization inter-allied nuclear force came into being, in fact if not in name, during the three-day NATO ministerial conference here last week. Increased liaison between the USAF Strategic Air Command and the inter-allied nuclear force also is expected to result from the meeting.

Creation of the inter-allied force was announced in a carefully worded communique which said representatives of the 15 NATO nations were in general agreement to reinforce and regroup the alliance's nuclear strike forces "taking into note several steps which already are being taken."

The newly created force will be composed of three major units:

- **Three U.S. Polaris-firing submarines** which presently are stationed in the Mediterranean area.
- **Great Britain's** 180-aircraft nuclear strategic strike force of V-bombers presently in RAF's Bomber Command.
- **Nuclear-capable fighter-bomber squadrons** of the other NATO nations, including two French squadrons based in West Germany, which will be armed with U.S. nuclear warheads.

The agreement also provides for creation of a unified target planning staff, probably headed by a Dutch officer, which will coordinate target planning for the combined force. The planning staff will be under the command of Gen. Lyman L. Lemnitzer, supreme Allied Commander in Europe.

Recommendations were made by the council to include officers from other NATO nations on the liaison team at SAC headquarters in Omaha, Neb., to bring the inter-allied target planning staff into closer coordination with the SAC group.

As a preliminary step to this, a group of NATO officers will be flown to SAC headquarters following the ministerial conference, for briefings on targeting operations.

Decision to ratify creation of the inter-allied force informally was a political one, aimed at mollifying the French, who have opposed creation of the force on the grounds that it would prevent them from creating their independent nuclear force. Britain, on the other hand, whose strategic strike force operation previously has been planned in conjunction with those of the U.S. and then coordinated with the other NATO nations, had been expected to press for formal creation of the unified force.

The official communique, issued at the close of the first day's session, however, said the ministerial council agreed unanimously on all points discussed.

Two other major points discussed during the first day's session included the need for achieving a better balance between nuclear and conventional forces in Europe and the progress being made in the creation of a NATO multilateral nuclear force.

Both issues were tabled, with the nuclear-conventional force balance issue scheduled for further discussions by the permanent NATO council in Paris.

The multilateral force would be composed of mixed national crews on Polaris submarines and Polaris-equipped surface ships. It would also require increased sharing of the financial burden by the U.S. as NATO allies. The formation of the force was discussed briefly and then tabled because "time was not ripe for further discussions of such a force."

The U.S. supported creation of such a force to integrate more fully NATO's nuclear force and at the same time to ensure that a greater portion of the burden of defending Europe would be assumed by her allies. The U.S. apparently agreed to compromise on an immediate move to create the inter-allied force in order to prevent a rift in the NATO alliance.

In his speech to the council, which heard representatives from all 15 NATO nations, Secretary of State Dean Rusk said that it was the aim of the U.S. to remove all doubts as to whether it was committed to a nuclear as well as a conventional warfare defense of Europe.

This gave credence to reports from some U.S. officials that the U.S. did not feel there was a great need for a unified NATO nuclear force because SAC's nuclear strike force was already committed to Eastern European targets. SAC's force would be committed if an all-out attack was made on Western Europe. The U.S., according to some officials, is seeking creation of the unified force primarily to convince its NATO allies that it is committed to a nuclear defense of Europe.

Pan Am Considers Jet Commander

Pan American World Airways, still negotiating with de Havilland on the purchase of approximately 40 DH-125 executive turbojet transports, has started discussions with Aero Commander in the event of a breakdown in talks with de Havilland.

De Havilland said last week that "considerable difficulty is being experienced in finalizing the detailed terms of the proposed agreements."

As a result of these difficulties, both Pan American and de Havilland appear to be turning elsewhere, although talks between the two companies apparently are continuing.

Pan American representatives were in London recently discussing the possibility of using the General Electric CF-700 fan engine. Pan American wants the aircraft to have an additional fuel tank to provide more holding time at congested airports.

De Havilland, meanwhile, announced the U.S. delivery price of the DH-125 as $575,000, minus cabin interior and electronics. Factory-installed, six-seat interior would cost an additional $17,000. De Havilland also is investigating the possibility of a DH-125 sales and service system in the U.S. utilizing regional distributors, probably fixed-base operators with experience in maintaining executive aircraft which use turbine powerplants.

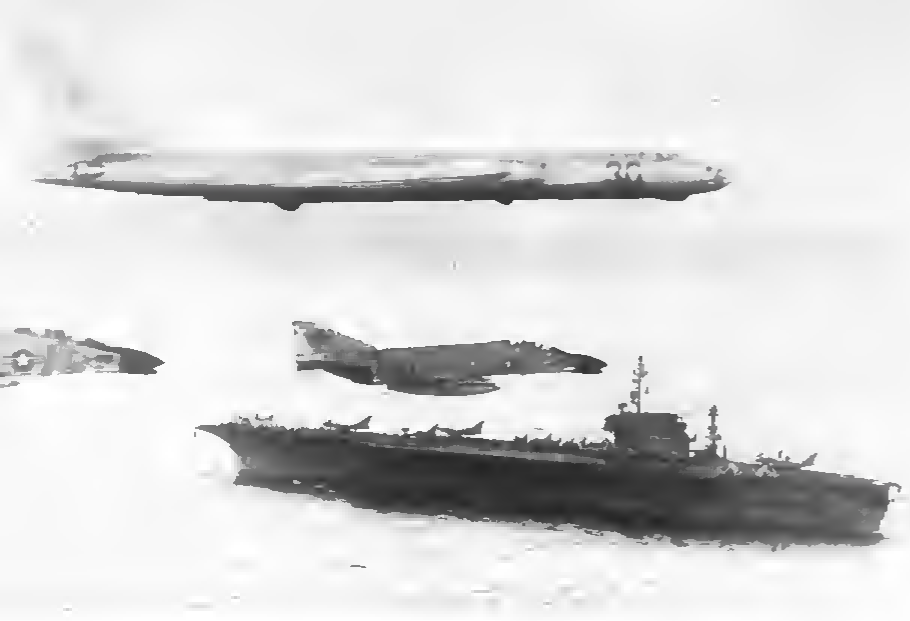
De Havilland is believed negotiating five U.S. sales to other customers.

Pan American heard presentations by Aero Commander officials in New York recently regarding the company's Model 1121 Jet Commander. The airline is expected to send technical personnel to Aero Commander's Bethany, Okla., headquarters soon to evaluate the aircraft, which is in flight test.

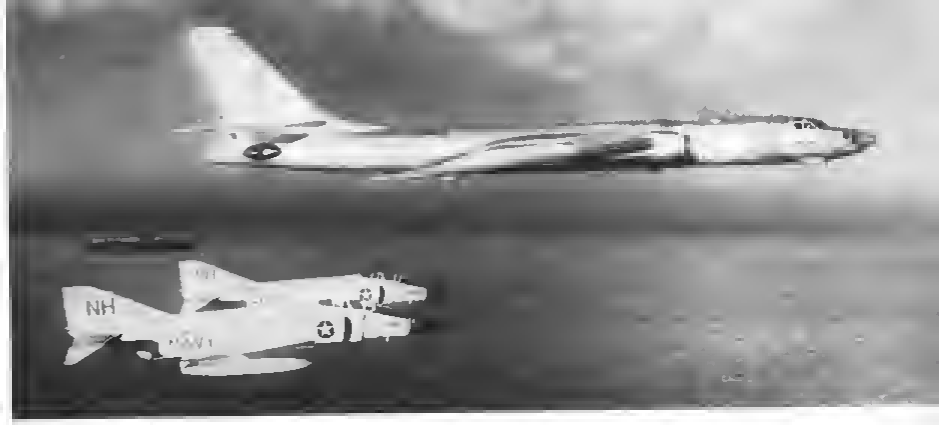
Pan American also has studied the French Dassault Mystere 20, but there are no indications as yet of talks by the two companies.

Other turbine-powered executive aircraft also have been making sales progress:

- **Lockheed JetStar** sales are showing an upturn and there are indications that the company plans to authorize a production block of 10 aircraft on the basis of five recent civilian orders.
- **North American's** executive Sabreliner distributor, Rennert-Werner, is negotiating sales of approximately five of the twin-jet planes.
- **Beech Aircraft Corp.** will continue to keep the Model 120 twin-turboprop project on a standby basis while it accelerates its development of the Pratt & Whitney PT-6-powered Queen Air. The turboprop Queen Air prototype started flight tests recently under a development program for the Army. If this program leads to a production contract, Beech probably will enter the civil market with this aircraft prior to introducing the Model 120 Pressurized piston-engine Queen Air, now under development, will be a logical aircraft to be fitted with PT-6s.



Soviet Badger Two-Plane Team Shadows Carrier



Closely escorted Soviet Tu-16 Badger reconnaissance aircraft makes a low-altitude pass that carries it almost over the U.S. carrier Kitty Hawk in the North Pacific Ocean. The Badger with serial number 30 was one of a two-plane element (bottom, facing page) using the Soviet tactic of having one aircraft operate as spotter to recognize a ship by its electronic signature and the other as pathfinder to the ship (AW Mar. 25, p. 22). Badger No. 35 carries underwing stores, possibly electronic gear. Escorting Navy fighters are McDonnell F-4B Phantom 2s, seen with auxiliary fuel tanks in all photos, a Vought RF-8A (F8U-1P) photo-reconnaissance version of the Crusader (top in center photo) and an F-8C (F8U-2) with the Badger team (background in bottom photo facing page). Rectangle on the Badger ventral fin (right), which resembles a hatch, is not usually seen on this aircraft. Photos, released last week, were made during January. One was taken from the carrier flight deck (below).

USAF, Army Air Roles Evolving Slowly

By Larry Booda

Washington—Zigzag line of demarcation is being drawn, role-by-role and mission-by-mission, to define the primary areas of aviation responsibility between the Air Force and Army. What both services had hoped would be a quick, clear action similar to the 1956 Key West agreement has turned into a prolonged, competitive proof and test period (AW Jan 14, p 26).

Both services have been aggressively implementing recommendations made by two study boards last year, while Defense Secretary Robert S. McNamara and his advisers monitor the actions and make decisions when necessary.

Neither the Army's Tactical Mobility Requirements Board, headed by Lt Gen Hamilton H. Howze, nor the Air Force Board headed by Lt Gen Gabriel P. Disosway organized to review the Howze board findings have won clear-cut victories. In fact, both have been rebuffed by McNamara.

A principal argument of the Howze board was that pilots must have a "feel" for the Army environment. The only way to accomplish this, the board said, is for pilots to live and work with the Army in the field.

The Disosway group, on the other hand, claimed that airmen need not live with ground forces to understand them. "The tactical commander and Army commander need not live in the same tent," the board said.

This question was resolved when Gen Walter C. Sweeney, head of the Tactical Air Command, late last year ordered all TAC officers and men in the field to wear the Army standard olive green uniform. Only the rank or rate and the arm patch distinguishes Air Force personnel from Army personnel.

On the other hand, Gen Disosway said that the charter for the Howze board included a requirement to appraise the capabilities of the Air Force. This was not done, he said.

McNamara Support

McNamara backed the Air Force on this point by saying in testimony before Congress that Gen. Howze "did not take full account of the extent to which the Air Force could supply and perform some of the functions which the Howze board recommended the Army provide ... two functions in particular, one, mobility, near battlefield mobility, movement of supplies into the battlefield, etc., and ... close support.

"I suspect that on both of those counts ... we will find that the Air Force can give far more support to the Army than the Army assumed or that the Howze board assumed," McNamara said.

The Howze board, in a sense, represents the aggressive initiative in aviation the Army has taken in recent years. The Disosway board represents a rebuttal attitude, a rearguard action while the Air Force tries to retain the initiative.

The Howze board recommended a broad expansion of Army aviation, centered in an air assault division using 459 aircraft. Most of these aircraft would be assigned to a corps aviation brigade operating fixed wing and rotary wing aircraft for observation, reconnaissance and attack. An air transport squadron would have 134 aircraft.

The immediate goal would be one air assault division in Korea, one in Hawaii and two in the continental U. S.

Under the proposed five-year program, the Army would grow to 10 reorganized divisions and six air assault divisions. The number of each type of division could vary, but the total would remain at 16.

Current Program

The current Army aircraft program, now undergoing revision, calls for 4,887 aircraft in the inventory in Fiscal 1967. The board recommendation would increase this by 6,034 for a total of 10,922, of which 1,300 would be trainers.

The cost of the current force—$1.662 billion—would be increased to a total of $3.784 billion to pay for the new force. Some of this, about $1.981 billion, the board said, would be absorbed by elimination of drone programs, a family of trucks, some types of helicopters and some heavy armor.

Personnel programed for the current goals—6,500 officers, 2,200 warrant officers and 20,500 enlisted personnel—would jump to 10,300 officers, 10,300 warrant officers and 71,000 enlisted men.

The expansion program would be given special management attention similar to the Navy's Polaris program.

In addition, the Army would assume the role of advising the air forces of countries where counter-insurgency actions were taking place.

Disosway took sharp exception to these points. Another air force would be created if the recommendations were to be followed, he said. The division aircraft would grow from 459 in the present plan to 1,245 in the 1970s. The Army's 16 divisions would account for 30,000 aircraft and 42,000 pilots.

The Howze board divided its study into six parts: aircraft were recommended by type; a new organizational structure based on the air assault division was proposed; a program for testing the concepts was devised; costs in dollars and personnel were estimated; a course of action was proposed; and supporting arguments were presented.

Gen. Howze recommended that the Army provide its own aviation for special warfare missions aimed at training indigenous forces to combat insurgency actions by guerrilla forces. His report proposed activation of a special warfare aviation brigade in Fiscal 1963.

Loudest Controversy

It was this particular recommendation, along with the Army arming its helicopters in South Vietnam with machine guns to protect transport helicopters during assault actions, that touched off the loudest controversy between the two services in the latter part of 1962. The Air Force has now stepped up its training of Air Commandos and also development of specialized aircraft and equipment for the missions.

Gen. Disosway had devoted considerable space to comparison of relatively fast fixed wing aircraft with slower aircraft for the close-in support mission. He said that there was no authoritative definition of close-in support. Howze agreed with him in asking for definitions in a policy statement. He compared the McDonnell F-4C Phantom 2 with the Grumman AV-1 Mohawk attack version of the OV-1 by saying that the former has six times the firepower and 2.5 times the speed. In addition, it can perform the air superiority mission, he said.

The Air Force board also quarreled with the placement of aircraft control with local commanders instead of over-all commanders. The local control concept is based on the Army's forward area method of operation, the board said, but this takes away the advantage of versatility in assignment of aircraft where they are needed most. No option is given the over-all commander, they argued. Communications between local and over-all commanders to rearrange aircraft forces would take longer than a mission operated from farther back, the board said.

The Disosway group also said that the Howze board had not presented enough substantive data to support the new concepts, that insufficient operations analysis had been put into the studies and that the weapon systems proposed were incomplete in the scope they covered. Another point the Air Force board made was that the views of the U. S. unified and specified commands were not considered by the Howze board.

Gen. Disosway aimed his study at roles and missions, command and control, close air support, counter-air and interdiction, tactical reconnaissance and airborne assault.

Both boards recommended field testing. McNamara has backed this idea by requesting initially $50 million from Congress. This was later broadened to "from $50 million to $75 million." McNamara said: "I don't really believe we will have any roles and missions arguments, and I think the Air Force is willing to consider the Army's problems. Now that we have increased the two portions of the Air Force that relate directly to the Army, the airlift and the tactical fighter support, and now that the Air Force clearly understands the extent to which they finance future increments in these two types of aircraft, they will not be asked to reduce their strategic nuclear forces. I see no reason why we can't anticipate increasing support of the Army by the Air Force. If that be the case, I don't anticipate a roles and missions argument."

These are the aircraft requirements envisioned by the Howze board:

- **Reconnaissance** — Grumman OV-1 Mohawk.
- **Attack helicopter**—Bell UH-1B Iroquois.
- **Attack plane**—Grumman AV-1.
- **Utility helicopter**—Bell UH-1B.
- **Tactical transport**—Bell UH-1D.
- **Ambulance**—Bell UH-1B Iroquois.
- **Command staff plane**—Beech U-8F Seminole.
- **Utility plane**—Helio U-10A Courier.
- **Cargo helicopter**—Vertol CH-47B Chinook.
- **Transport plane**—De Havilland CV-2A Canbou.
- **Heavy lift helicopter**—Sikorsky S-64 Skycrane.
- **Observation helicopter**—LOH (light observation helicopter).
- **Command and control**—LOH.

The board also named a number of aircraft assigned to other services which would be used in support of the Army. They are: Douglas A-4E Skyhawk, Grumman A-6A Intruder, Douglas A-1S Skyraider, McDonnell F-4B Phantom 2, Lockheed F-104 Starfighter, McDonnell RF-101 Voodoo, Fairchild C-123 Provider, Lockheed C-130 Hercules, Lockheed C-141 and Douglas C-133 Cargo Master.

Aircraft weapons recommended by the board were two machine guns and 650 rounds of ammunition for the Bell H-13 and Hiller H-23 Raven helicopters; two M-60 or XM-2 machine guns for the LOH, Vertol HH-21C Shawnee and Kaman HH-43B; four machine guns for the Bell UH-1A, two pods for 2.75-in. rockets or two XM-3 machine guns for the UH-1B, rockets, machine guns or M-39 cannon for the AV-1.

The Disosway board recommended that the Air Force be authorized 25 tactical air wings, the procurement of F-4Cs be substantially increased, that a V/STOL fighter such as the Hawker P.1127 be developed, tactical reconnaissance squadrons be increased from four to 20 squadrons, C-130 squadrons be set at six and that a heavy cargo transport, the CX-4, be developed as a follow-on to the Douglas C-133.

The F-4C purchase has since been increased, the C-130 buy has been approved in principle and the C-133 follow-on aircraft work is proceeding.

Gen. Disosway also envisioned a three- to five-ton payload VTOL transport and 12- to 20-ton payload helicopters. He said that the C-130 was much superior to the CV-2A, having a 10-to-1 load factor advantage in its STOL version.

Ever since the Army Ground Forces were given permission in 1943 to have their own organic liaison and observation, instead of assigning the tasks to the Army Air Forces, there has been controversy over the air tactical and logistic support for the ground forces.

After creation of a separate Air Force, the Army continued to pay more attention to support of troops. During the 1950s the Air Force was preoccupied with massive nuclear retaliation. Even tactical air support was based on used of nuclear weapons.

The 1956 Key West Defense Dept. conference set a limit of 5,000 lb. weight on Army aircraft with exceptions to be granted only by the secretary of defense. These exceptions were granted in the case of utility fixed wing aircraft, several helicopters and Mohawk and the Canbou.

The change of administration in 1961 brought a policy change that emphasized less than all-out nuclear war and use of conventional weapons. The present situation is an outgrowth of this change in thinking.

The Army now thinks that its area of aviation responsibility encompasses the rough fields near a front and the aircraft—whatever size is necessary—to operate from them. It also wants its own procurement organization for aircraft and related equipment.

USAF Compiling Space Projections

Air Force projections for operations in space are being compiled in a group of reports which will be submitted to Defense Secretary Robert S. McNamara in mid-June.

Analyses are being prepared by Space Systems Div. in conjunction with Aeronautical Systems Div., Air Force Special Weapons Center, Aerospace Corp., and other USAF facilities. They constitute a response to a Defense Dept. request for USAF to supply data on systems to satisfy basic military space missions.

Reports will encompass some of the critical subjects which will be explored in detail in Project Forecast (AW Apr. 15, p. 39) now being developed to clarify the Air Force's structure through the 1970 decade. The reports are expected to cover these operational areas:

- Manned and unmanned space vehicles. SSD probably will include in this analysis the concept of a standard universal module for manned or unmanned operation with maneuvering capability for rendezvous (AW, Apr. 8, p. 29).
- Interception, inspection and destruction of non-cooperative, potentially hostile satellites. This projection would incorporate some of the inspection concepts embodied in the down-graded Project 706 (Saint) satellite. These concepts have been considered for incorporation in a manned version of this satellite. The analysis also would consider the application of the standard universal module for this mission.
- Methods of protection for U. S. satellites. This would be the reverse of the preceding category. It would incorporate analysis of means for coping with anticipated inspection and destruction techniques which might be employed by hostile satellites.
- Weapons and associated launch techniques from space deployment modules. This analysis would consider the feasibility of deploying weapons in relatively low altitude orbits, and would include refined programing and targeting techniques.
- Manned orbiting development station. This study would be a revival and extension of a USAF concept proposed to DOD previously for a space vehicle to demonstrate basic Air Force operating capability in space. USAF has not been successful in obtaining DOD approval to implement this type of program. The new analysis probably will examine capability of the USAF Boeing X-20 (Dyna-Soar) space glider to conduct the manned development station mission.
- Use of USAF's Dyna-Soar and the NASA-McDonnell Gemini spacecraft for Air Force space missions. This will be an analysis of ability of both these vehicles to initiate an operational regime in space. Boeing has supplied data on Dyna-Soar to USAF for this category.

Former Key TFX Official Attacks Choice

By George C. Wilson

Washington—Strongest attack yet on Defense Secretary Robert S. McNamara's F-111 (TFX) contract decision was made last week when one of his former civilian tactical aircraft specialists said "there is no real, supportable case to be made for his choice [of General Dynamics-Grumman] on the grounds of operational, technical, management or cost considerations."

Albert W. Blackburn, aeronautical engineer and former test pilot, told the Senate Permanent Investigations Subcommittee that McNamara awarded the $6.5-billion contract "on the basis of information different from that evaluated under the established ground rules."

Blackburn was a special assistant in the office of defense research and engineering until last Mar. 25. The F-111 tactical fighter program was his primary task from its inception until the award last November. Blackburn resigned during a policy dispute over the F-111 case.

He said he had intended to leave the Pentagon anyway, and had notified his superiors last January. But he said his objection to McNamara's F-111 red and blue teams, first detailed by AVIATION WEEK & SPACE TECHNOLOGY (Apr. 29, p. 23), reinforced his determination to leave.

Blackburn served on the red team, which was to make the case for Boeing in what he termed "a kind of devil's advocate exercise to assure that all possible challenges to the secretary's position were anticipated." He said the red team relied on data compiled by the evaluators who had spent 275,000 man-hours on the F-111 project, while the blue team to support the choice of General Dynamics-Grumman, was "generating new information" not on hand when the decision was made. He said red team members were asked to endorse the conclusions of the blue team, but refused to do so. He said he understood, but was not sure, the original request for the endorsement came from McNamara. But a blue team member made the request directly to red team members, Blackburn said.

He also told the subcommittee that:

- **General Dynamics** was in "an atmosphere of complete panic and confusion" last June 16 when it presented four designs in trying to satisfy Navy objections during the third round of competition with Boeing.

"Upon conclusion of this presentation," Blackburn said, "the impact on those who had received it was generally that the whole concept of a bi-service TFX development had been completely lost. That afternoon the Boeing Co. presented their answers to the Navy problem and a more workmanlike and professional approach, coupled with real imagination applied to the Navy problem could not have been asked for."

"Not only a common design [was] preserved, but it appeared even to the most critical of Navy technical observers that for the first time one of the two competitors had come to terms with their problem and offered realistic solutions. There was no doubt in anyone's mind as to the relative competence of the two competing companies," Blackburn said. But McNamara directed that the competition be continued another 90 days.

- **General Dynamics'** proposal for the the fourth and final round of competition, incorporated "all the imaginative aerodynamic fixes devised by Boeing in their third submission to satisfy the very difficult Navy maneuver requirements to a degree of similarity that would hardly be coincidence." Boeing had prepared itself for the fourth round by conducting wind tunnel tests and making aerodynamic refinements in the design, Blackburn said.

Frank W. Davis, president of General Dynamics' Ft. Worth Div., issued a rebuttal statement the day Blackburn testified. He said his company's previous testimony "proves our design was different and superior. Any implication that our design sprang from a source other than the General Dynamics-Grumman team is not even worthy of comment" (AW May 20, p. 104).

- **It was clear to all those involved,"** Blackburn testified, "that this decision [to award General Dynamics the contract] could be justified only on the basis of a broad high-level policy of the Administration and could not in any way be associated with the merits of the two proposals on either an operational technical, management or cost basis."

Damage done "to our entire design competition structure" would have been less if it had been explained that "higher level problems of depressed areas, geographical spread of so large an effort and the importance of the outstanding Ft. Worth facility caused a reversal," Blackburn said. "It is difficult to imagine that several hundred top technical experts from Wright Field and the Bureau of Weapons could again with such seriousness of purpose and over such a long period of time, including many seven-day weeks, so enthusiastically seek to accomplish the choice of the superior weapon system proposal in another such competition when the total effort expended by them is, from their point of view, completely negated by an executive decision."

Air Force Secretary Eugene M. Zuckert in his Nov. 21, 1962, memorandum justifying the selection of General Dynamics, said the summary of ratings in the fourth evaluation gave General Dynamics the edge "in the technical areas of air vehicle, propulsion, flight control, secondary power and environmental control, mission and traffic control, aerospace ground equipment, crew provisions and personnel subsystems. "These favorable areas," Zuckert said, "in our opinion outweigh the deficiencies in offensive systems reconnaissance and penetration aids." He said "the favorable rating in production program planning and cost realism provides much credibility to General Dynamics in areas with which we are particularly concerned."

- **There is "serious doubt"** that thrust reversers can be added to the General Dynamics aircraft without a major redesign of the airframe. Blackburn said. This contrasts with McNamara's statement before the subcommittee last Mar. 13 that "in selecting the General Dynamics proposal we retained the option to apply thrust reversers to the aircraft design" (AW Mar. 25, p. 31).

Blackburn said flying aircraft with thrust reversers convinced him that they were so valuable for in-flight control that any tactical jet aircraft built without them will be obsolete.

- **McNamara's commonality arguments** ignore the added expense of conducting assembly, check-out and flight testing at two different places—Grumman's Bethpage, N. Y., plant for the Navy F-111 and General Dynamics' Ft. Worth, Tex., plant for the USAF version. He said plans for these separate operations were known when McNamara chose General Dynamics. Last year, he said, McNamara's office opposed production of the McDonnell F-4C in two separate plants on grounds it would increase costs by $100 million. With assembly, check-out and flight testing conducted at two locations under different service jurisdiction, "retention of any significant commonality after the first year of production will be a major management miracle."

- **"Significantly less"** changes would be needed in the Boeing design because it was started earlier and had been refined more while the "hastily put together" General Dynamics proposal "was essentially a completely new design between the third and fourth evaluations." Blackburn said Boeing had twice as many engineers as General Dynamics-Grumman on the F-111 project. He said Boeing's design was less complicated also because its wing has 11.5 deg. less sweep than General Dynamics'.

- **Honeycomb construction** to be used by General Dynamics-Grumman has such "serious limitations" that Defense Dept. experience with it to date indicates it "should be avoided wherever possible." He said troubles with the honeycomb structure on the North American RS-70 have delayed the program by six months. The straightforward sheet and stringer structure proposed by Boeing was preferable.

Despite his own preference for the Boeing design, Blackburn urged the subcommittee "not to take any action which would delay the operational availability of this important new weapons system." He said the F-111, no matter who builds it, will be three to five times better than any tactical aircraft flying today.

McNamara's $1-Billion TFX Saving Hypothetical

Washington—Rough estimate based on a hypothetical case was identified last week as the basis for Defense Secretary Robert S. McNamara's widely publicized inference that his choice of General Dynamics-Grumman for the F-111 (TFX) contract eventually will save $1 billion.

Albert W. Blackburn, whose job during the F-111 competition was to concentrate on ensuring a common aircraft design for both services, told the Senate Permanent Investigations Subcommittee that Dr. Harold Brown, defense director of research and engineering, asked him for "a rough estimate of savings that might result from the bi-service airplane." Blackburn came up with a figure of $1 billion. He said it was the first and only estimate made by anyone as far as he knows.

McNamara said in a sworn statement read to the subcommittee on Mar. 13 that he was convinced "if we could achieve a single tactical fighter, we would save at least $1 billion in development, production, maintenance and operating costs."

After saying that the General Dynamics-Grumman Air Force and Navy versions of the F-111 were more similar than Boeing's, McNamara said: "If I had approved what was essentially two different airplanes, the prospects of saving $1 billion would have evaporated."

This has left the impression that choosing General Dynamics-Grumman over Boeing saved $1 billion, as the following subcommittee discussion last week shows:

- **Sen. Karl E. Mundt (R-S.D.)** Everybody has picked up your figure . . . That, as I understand it, was an estimate regardless of contractor, and regardless of design, that you just took a hypothetical plane, a bi-service plane, and said if you can get it and make it work and do the work of two planes, you ought to save $1 billion, and it had no relationship to General Dynamics or Boeing or any of the other four earlier contractors.

- **Blackburn:** That is right, Sen. Mundt. Yes.

- **Sen. Henry M. Jackson (D-Wash.):** Lest the record be confused, it is my understanding that your statement in response to Sen. Mundt's question of $1 billion savings does not relate, however, to the matter before the committee, that is the proposal by General Dynamics, is this not correct?

- **Blackburn:** This was made relative to a TFX airplane when we did not even know who the bidders might be.

- **Sen. Mundt:** Do you recall what construction figure you had in mind when you made the estimation of the $1 billion saving?

- **Blackburn:** The technique was a very simple one, Sen. Mundt. I simply took history of aircraft of similar performance, and I formalized these numbers. That is, I made the numbers fit the TFX program in so far as the numbers of test aircraft were concerned, to get the R&D cost. I had to extend the numbers for recognized, or what I felt were to be recognized, inflationary figures. For an airplane built in 1958, its cost historically must be increased by inflationary factors, and in this way also I had to look at the total size of the airplane and adjust for the weight of the aircraft. And all of the aircraft I used were in the same general performance envelope as the TFX.

Blackburn explained that after obtaining total costs for the Air Force and Navy developing, producing and operating similar aircraft on their own, he then calculated the cost of using one design and one contractor and estimated the saving.

Snap 10A Launched

Washington — Non-radioactive Snap 10A reactor mockup weighing 482 lb. was launched successfully as the payload of a Scout rocket from Wallops Island, Va., May 22 to assess means of destroying a space reactor when it re-enters the atmosphere. Results had not been announced late last week.

News Digest

Army competition for off-the-shelf purchase of aircraft suitable for instrument training will be held in June. Contracts will be awarded for 60 twin-engine, fixed-wing aircraft, 60 medium helicopters and 232 light primary trainer helicopters.

Aeronutronic Div. of Ford Motor Co. has been awarded two Air Force contracts totaling more than $19 million for manufacture of decoy subsystems for Atlas F and Titan 2. It will be Aeronutronic's first major aerospace production program.

Prime Minister Lester Pearson's month-old Canadian government narrowly defeated a no-confidence vote in parliament last week on the nuclear arms issue with the help of two Conservative and four Social Credit party members. Motion was made by New Democratic party leaders and supported by former Prime Minister John Diefenbaker's Conservatives.

Cold-flow tests with Kiwi B-4A reactor at the Nuclear Rocket Development Station, Mercury, Nev., have indicated that failure of a Kiwi reactor during hot run last Nov. 30 (AW Dec. 24, p. 25) resulted from vibrations due to flow characteristics of the liquid hydrogen propellant through reactor core.

Army is studying a modification of Nike-Hercules as an anti-missile system to counter the Soviet FROG battlefield tactical missile. Modifications to the basic Hercules will be held to a minimum and will primarily be in the area of improved radar tracking and guidance equipment.

Army aircraft supporting South Vietnam forces against Viet Cong communist guerrilla forces up to last month had flown about 75,000 sorties and had carried approximately 236,000 troops and other passengers. Aircraft losses during the same period have totaled 24 from all causes, including accidents.

Garrett-AiResearch, Los Angeles, will build pressurization, air-conditioning and hot air, anti-icing systems for the Douglas DC-9 short range jet transport under a $5,808,625 contract from Douglas Aircraft Co.

Rolls-Royce Spey-powered Blackburn Buccaneer S. Mk.2 naval strike fighter made its first flight recently. Both the British Royal Navy and the South African government have ordered the fan jet aircraft. Earlier versions of the Buccaneer were powered by two Bristol-Siddeley Gyron Jr. turbojets.

Airlines Are Bystanders in Fare Dispute

IATA efforts continue, but decision now rests with governments; U. S. attitude arouses Senate group.

By L. L. Doty

Washington—International fare controversy has become a conflict between governments, with the airline industry forced to sit nervously on the sidelines waiting for a solution which it hopes will permit resumption of normal competitive operations.

As of late last week, the U. S. had made no progress in breaking the rate impasse that has left the U. S. airlines uncertain about what to charge and passengers confused over what a trip will cost. The British remained adamant in their position for higher fares (AW May 20, p. 39) while the Civil Aeronautics Board groped for a compromise that would satisfy the British and mollify an angry Senate Commerce Committee.

The governmental battle has resulted in control of the complicated techniques of rate structures being wrested from the airlines and placed in the hands of politicians. The British position has been strong because of its government's concern over the effect British Overseas Airways Corp. deficits are having on the British budget. The U. S. stand has been weak because of the State Dept.'s indifference toward air transportation.

An "informal" traffic conference of the International Air Transport Assn. was to be held in Montreal late last week, after an earlier meeting in Bermuda failed to arrive at a settlement. However, it is obvious that the airlines—in this instance—have little power to make their influence felt at high governmental levels where it counts.

Reluctance of the airlines to commit themselves to a rigid stand is borne out by the "position vote" taking during the Bermuda traffic conference. Only 11 airlines indicated they would oppose a 5% fare increase on a worldwide basis. They were Air India, Avianca, El Al, Finnair, Caruda, Iraqi, LAN, Middle East Airlines, Panagra, South African Airways and United Arab Airlines.

It is noteworthy that airlines openly committed to lower fares—U. S. and Canadian carriers and Japan Air Lines—abstained from voting. Mexico abstained, but was known to have been considering voting against the Chandler fare. Only LAN of Chile was willing to go on record in its stand against the fare boost.

IATA traffic conference machinery has been incapacitated by the current dispute, but this is very likely a temporary situation. Predictions that the IATA influence in industry affairs has been weakened permanently overlook a number of elements in the traffic conference structure.

To begin with, the dispute over whether the round-trip discount on North Atlantic fares should be reduced from 10% to 5% is but a small factor in the over-all tariff structure, which involves thousands of rates and overlaps into such areas as services, equipment, tickets, baggage tags, reservations codes and procedures, packaging regulations, currencies, law and commercial practices.

H. Don Reynolds, IATA traffic director, has compared traffic conference machinery to a computer that analyzes and consolidates hundreds of different operating principles and economic philosophies into a single tariff structure acceptable to more than 90 international airlines. This is work for a professional tariff expert and it is fair to say that rate-making is in the hands of amateurs when performed by politicians.

In addition, the IATA clearing house is an essential function of the organization and an economic necessity to the airlines. Legitimate criticism of IATA could be directed to an ineffective executive committee and the group's annual general meetings which accomplish little and which CAB Vice Chairman Robert Murphy has termed IATA's "annual prayer meeting."

State Dept. has often been accused of compromising international airline issues for more important foreign policy considerations. However, industry observers were hopeful that the forthcoming reorganization of the State Dept.'s aviation division (AW May 6, p. 38), and the new international air policy (AW Apr. 29, p. 34) would strengthen U. S. dealings with foreign nations on international air transport matters.

However, the State Dept.'s capitulation on the Chandler fare crisis suggests that the U. S. position in this area is still flaccid. One industry official told AVIATION WEEK & SPACE TECHNOLOGY, "policy or no policy, it's still all give and no take."

It is now apparent that the State Dept., by its action (AW May 20, p. 39), has undermined the Administration's new policy, leaving Congress to restore as much of its strength as now possible. Meanwhile under the reorganization plan, State Dept. will pursue international civil aviation matters under the guidance of officials who have little or no experience in the airline field. Indications now are that airline specialists who are assigned to State Dept. will be bypassed during the reorganization.

Last week, Sen. Warren C. Magnuson (D-Wash.) promised to take legislative steps that would give the U. S. more power in handling future international rate problems. Although the legislation will give rate-making authority to the CAB—where most observers agree it belongs—the new law is not likely to bring an immediate solution to the present dilemma.

In addition, there is a strong disagreement between the airline industry and the Administration as to how broad this legislative authority should be. Stuart G. Tipton, president of the Air Transport Assn. last week said the CAB should have power to suspend fares but should not have rate-fixing authority, as called for in a Senate bill proposed by the White House.

Tipton told the Senate Commerce Committee last week that "... growth of international air transportation has been based on the concept that the public interest is best served when international rates are established by the airlines with government approval and not by unilateral rate-fixing agreements." A second bill empowering the CAB to suspend rates in accordance with the IATA position was introduced in the Senate at ATA's request.

The bill proposed by the White House gives CAB the authority to regulate rates and practices of both U. S. and foreign air carriers in foreign air transportation, subject to the approval of the President. In sending the bill to Congress President Kennedy urged "... we should continue to press for rates we consider reasonable."

CAB holds that "we have no power under our present act to suspend or prevent a rate from going into effect," and insists that the Administration legislation is needed if the public interest is to be served properly. It is opposed to the industry bill. Boyd has stated that the public interest issue could not be applied to the current fare argument because of the small amount involved in the rate increase. With respect to any violation of the anti-trust laws, Boyd said this: "... we don't believe we could uphold an anti-trust action against our carriers where they are forced by a foreign government to apply a certain rate."

Prior to the London conference on the Chandler fares last month, Boyd admitted that other governments could enforce the Chandler fares and "ram them down our throats." But, he added, if this did happen, he would seek legislation that would give the U. S. broader rate regulatory powers. He noted then that the U. S. government could make U. S. carriers drop out of IATA. In any event, he said, "it is fair to say that we will take a greater interest in IATA in the future."

Late last week, Sen. Magnuson, committee chairman, promised quick action in pushing through legislation to give the CAB some control over international rates, although there was no indication which bill would be introduced into the Senate.

Sen. Magnuson cut short testimony of witnesses during his hearings held early last week, and said the committee would draft a final bill for introduction this week. He left the record open for any comments, but emphasized that the goal was to "get passage of a bill as quickly as possible."

Financial Comparison

Washington—Wide difference in the financial health of U. S. and foreign flag carriers drew attention during Senate Commerce Committee hearings on the international fare crisis. Asked why European airlines fail to show profits, Civil Aeronautics Board Chairman Alan S. Boyd said:

"It struck us as nothing less than amazing that our carriers could make money and some of the other carriers in the world lose money. Frankly, we didn't understand and we don't understand it. If they can't make money on the North Atlantic, I have serious doubts that they ought to be in business."

Sen. Warren Magnuson (D-Wash.), chairman of the committee, added: "I have too ... if our lines had that [subsidy], we probably could cut the fares in half ..."

Flight Forum Participants Believe U.S. Will Develop Mach 2 SST

Hartford, Conn.—Feeling that the U. S. will decide to develop a Mach 2 supersonic transport was widespread during the Connecticut General Life Insurance Co. Flight Forum here in spite of scattered protests that nothing short of a Mach 3 plane be considered.

Federal Aviation Agency Administrator N. E. Halaby has presented his recommendations on the project to a cabinet committee headed by Vice President Lyndon Johnson (AW May 20, p. 30). But in addressing the symposium he did not reveal them.

However, the prevalent opinion was that the government has decided not to try to cope with the many technical problems that a Mach 3 aircraft would present in development.

Approximately 450 top officials representing all phases of aviation finance and insurance attended the three-day session, the second sponsored by Connecticut General. The supersonic transport emerged as the principal theme in panel discussions with airline officials calling for caution in approaching the project and aeronautical engineers urging acceleration of the supersonic project and exploration of a hypersonic transport aircraft.

Most vocal proponent of the Mach 3 or higher speed transport was John Stack, vice president and director of engineering for Republic Aviation Corp. He called a Mach 2 project "hogwash" and said he would retire to his farm in Virginia if the U. S. undertakes development of Mach 2 aircraft of aluminum.

Hill Hibbard, senior vice president of Lockheed Aircraft Corp., said he was "disappointed and discouraged" over talk of a Mach 2 transport and told the group that a Mach 3 aircraft "must be built and it will be built."

Stack said an aluminum SST left no room for future growth in performance and range, and said only titanium and stainless steel construction would allow for increases in range and speed. On this point, Raymond Bisplinghoff, director of advanced research and technology for National Aeronautics and Space Administration, went one step further. "Minimum structural weight is imperative to the development of a reliable, efficient supersonic transport [but] because of temperature environment of the supersonic transport, more efficient structural techniques and long life materials are mandatory."

Bisplinghoff said a requirement for a hypersonic transport vehicle exists in the transportation spectrum for ranges between 5,000 and 10,000 mi.

"There appears to be no fundamental reason why the hypersonic aircraft suitable for such long-range transportation cannot be made eventually for military and commercial purposes," he said.

Halaby echoed a similar view, noting that "we must face the prospect of the hypersonic transport—speed and ranges of Mach 8 and 8,000 mi." Halaby also said the government should play a major role in the development of the supersonic transport.

In his report, Hibbard called for the development of a "Jet Liner" or "Air Bus," which he said could be available within 10 years if sufficient effort is put into the project. The aircraft will be a VTOL vehicle powered with lift engines having a 30:1 lift to weight ratio, which he forecast will be available within 10 years.

Hibbard called for a completely new concept of aerodynamics for the project and suggested that consideration should be given to whether wings are actually needed. "It would be highly desirable to have the vehicle flying on its own fuselage with the housing for passengers serving as its own airfoil," he said.

"With the elimination of flaps and other high-lift devices the cumbersome landing gear, most of the hydraulic system ... the Air Bus becomes practical from the economic standpoint while doing the metropolitan and short-haul job better than it has ever been done before," Hibbard said.

During a panel session conducted by Civil Aeronautics Board Chairman Alan S. Boyd, regulatory bodies came under some sharp criticism by Malcolm A. MacIntyre, president of Eastern Air Lines. He said managements are responsible for efficient airline operations, but authority to determine prices, establish routes or introduce untried services lies within CAB which is responsible to neither stockholders nor employes.

"One of the worst things happening on the authority side is that people won't talk to each other," MacIntyre said. He cited Eastern's flight engineer strike and said a government fact-finding board conducted an "abstract exercise" without consulting the CAB or the airline on the economic conditions of the industry or on whether the airline could cover any costs that might arise from a settlement.

He said that the FAA can and does impose new costs on the industry without determining whether the industry can support such costs and said he found it interesting that the CAB controls the economic welfare of the industry but "it is the FAA that makes economic forecasts."

Building Owners Fight Rooftop Heliport

By James R. Ashlock

New York—First organized opposition to the proposed helicopter operation from atop the new Pan Am Building in midtown New York came last week from owners of other skyscrapers near the structure.

Sources close to the issue interpreted the attack as an indication of the controversy expected when city approval is sought for New York Airways to begin scheduled operations from the heliport.

Spokesmen say it now appears that use of the heliport may be delayed much longer than earlier anticipated considering that all opposition must be heard and approval gained from several city agencies.

Signers of the protest were Samuel D. Leidesdorf, Irwin S. Chanin and Sol Goldman, all presidents of corporations owning buildings close to the Pan Am structure. Goldman heads the organization that owns the Chrysler Building.

"We believe that this rooftop heliport in the densely populated Grand Central area would present serious dangers to the public and that the noise from the heliport operation would be a burdensome nuisance to the occupants of nearby offices, hotels and residences," the three said.

Their protest statement was filed with the City Planning Commission, the Board of Estimate, the Federal Aviation Agency and the Dept. of Marine and Aviation.

Main emphasis of the statement was that the heliport is in a zoning district where heliports are unauthorized. That the heliport is being constructed prior to obtaining the proper zoning change is in itself a violation of city ordinances, the complainants charge.

Pan Am Building is located in a zone designated Commercial-5, which bars heliports. A change to Commercial 6 or Commercial-8 zoning is required and even in these the special permission of the City Planning Commission is necessary for heliport operations.

However, spokesmen for the City Planning Commission said that the owners of the Pan Am Building, whose organization is called Grand Central Building, had not violated any ordinances in building the heliport without obtaining the zoning change first.

A planning commission official explained that although the roof is designed primarily as a heliport that doesn't mean that it is restricted to such use. So far everything placed on the roof conforms to the zoning codes.

"Primarily, the structure up there now merely suffices as the roof of the building," the official said.

However, he emphasized that the application for the zoning change must be filed and approval granted before any helicopter operation can begin. The fact that such application has not yet been filed is the reason no public hearings on the issue have been scheduled, he said.

Grand Central Building's name must be on the rezoning application, even if it is submitted by the lessee Pan American World Airways. A spokesman for Grand Central Building said it had not been determined yet when the application would be filed.

"Everyone can rest assured that the proper procedures will be followed," he said.

Complainants also reminded the government agencies of New York Airways mishaps, including two forced landings in New York harbor. They suggested that for safety reasons, the heliport could be located on an East River pier near the United Nations, several blocks from the Pan Am Building.

They acknowledged the promotional advantage of a rooftop operation but said this was not sufficient justification in view of the noise and safety questions.

"The matter is of far too much importance to the safety and comfort of the public and there does appear to be any adequate benefit to compensate for the dangers and inconveniences that the project presents," they said.

Federal Aviation Agency's approval of the rooftop operation hinges primarily on a demonstration that it can be conducted safely. An FAA official said his agency is waiting for New York Airways to submit a pilot training program for flights off the roof. FAA would supervise the actual flights and base its approval or disapproval on its observations.

FAA officials have already participated in three helicopter flights to look over the lighting for night operations at the heliport. Lights illuminate not only the landing area, but the sides of the building immediately below the pad. The FAA spokesman said the lighting arrangement appears to be very good.

However, it is within the city agencies that the greatest delays in the heliport's opening are expected to be encountered. Spokesmen say many months could pass before all the required procedures are carried out.

Even after the City Planning Commission holds public hearings and approves or disapproves the rezoning, its recommendation must be submitted to other agencies such as the Traffic Dept. and the Board of Estimate.

Also involved is the Dept. of Marine and Aviation, which is responsible primarily for judging the heliport's safety factor. The Port of New York Authority is not involved, since the heliport is located on private property.

Spokesmen say also that because of the new considerations posed by a midtown heliport, there is a question of which city agency has right of approval.

Pan American and New York Airways encountered this question when they sought approval for a helicopter landing on the roof to dramatize the building's dedication on Mar. 7.

"Everyone in the city was very nice and seemed to favor the idea, but we just couldn't determine in time who the approval had to come from," a spokesman said.

Even test flights, which New York Airways must conduct for FAA approval, may be delayed for a long time.

"The question is, do test flights constitute establishment of the roof as a heliport," a Dept. of Marine and Aviation spokesman said. "Somehow, we'll have to decide that one."

New York Airways bases its qualification to operate from the roof primarily on having Boeing Vertol 107 aircraft. With twin turbine powerplants, the V-107 is capable of vertical flight and is certified as being able to fly with one engine inoperative.

The airline is planning to equip its V-107s with a higher-powered version of the General Electric CT58-110 engine, which would increase the shaft horsepower per engine from 1,250 shp. to 1,350 shp. The 200 shp. increase per aircraft would substantially improve the vertical flight performance. New York Airways officials said.

New York Airways has also ordered two more V-107s, which will bring its fleet total to eight (AW May 13, p. 38). A fifth V-107 already on order is expected in three weeks, with the newly ordered aircraft scheduled for delivery in about 14 months.

Robert L. Cummings, president of the airline, would not disclose details of the financing to cover the cost of more than $2 million for the three new aircraft and spare parts. The financing program will also include $1 million in working capital which New York Airways needs as a result of its record $377,629 loss in 1962.

Cummings said seven aircraft should enable his airline to hold direct operating costs to about 11 cents per available seat mile, which is three cents less than was attained with four aircraft. The seven helicopters should also bring the break-even load factor disregarding subsidy, down from 82% to 61%, he said.

Cummings said that from Jan. 1 through Apr. 30, New York Airways carried 74,000 passengers, compared with 45,000 in the same period of 1962. Predicted passenger volume for May is 26,000, almost double the 13,648 persons carried in May, 1962.

Precision VOR

Dayton—Federal Aviation Agency is developing a new precision VOR station that is expected to yield as much as a five-fold improvement in accuracy over present facilities.

Details of the new development, intended for use in the 1970s or earlier if needed, as part of FAA's Super Vortac navigation system, were disclosed by Alexander B. Winick of the agency's system design staff during the recent National Aerospace Electronics Conference here.

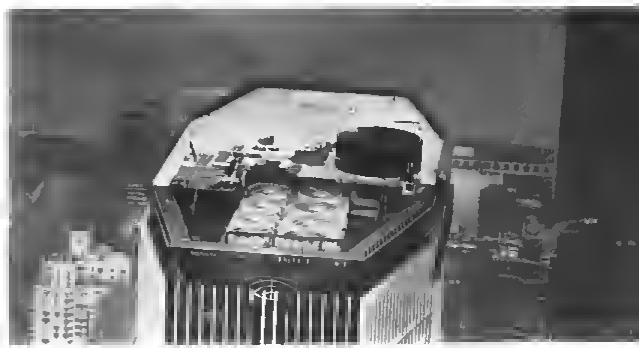
The new type VOR will be fully compatible with existing airborne equipment providing conventional service to existing receivers, or the higher accuracy to aircraft equipped with a small adaptor, Winick said. Present tests by Airborne Instruments Laboratory using calibrated airborne receivers show over-all errors—ground and airborne equipment—of about ½ deg., but Winick expects that 1-1½ deg. will be a more realistic operational figure.

Concept for the compatible precision VOR is credited to FAA engineers who devised the idea of modifying the newer Doppler VOR, which FAA uses at difficult siting locations, to provide the more accurate service. The 52-element antenna array of the Doppler VOR is modified to transmit a 13-lobe signal in addition to the standard one. It is transmitted on a subcarrier displaced 7 kc. from the main carrier frequency in presently unused spectrum between the VOR voice channel and Doppler subcarrier.

World's Fair Shuttle

New York—Numerous city agency clearances required for formal approval of the Pan Am Building roof as a heliport could block the site's use as a terminal for helicopter shuttle flights between Manhattan and the 1964-65 World's Fair at Flushing Meadow, Queens.

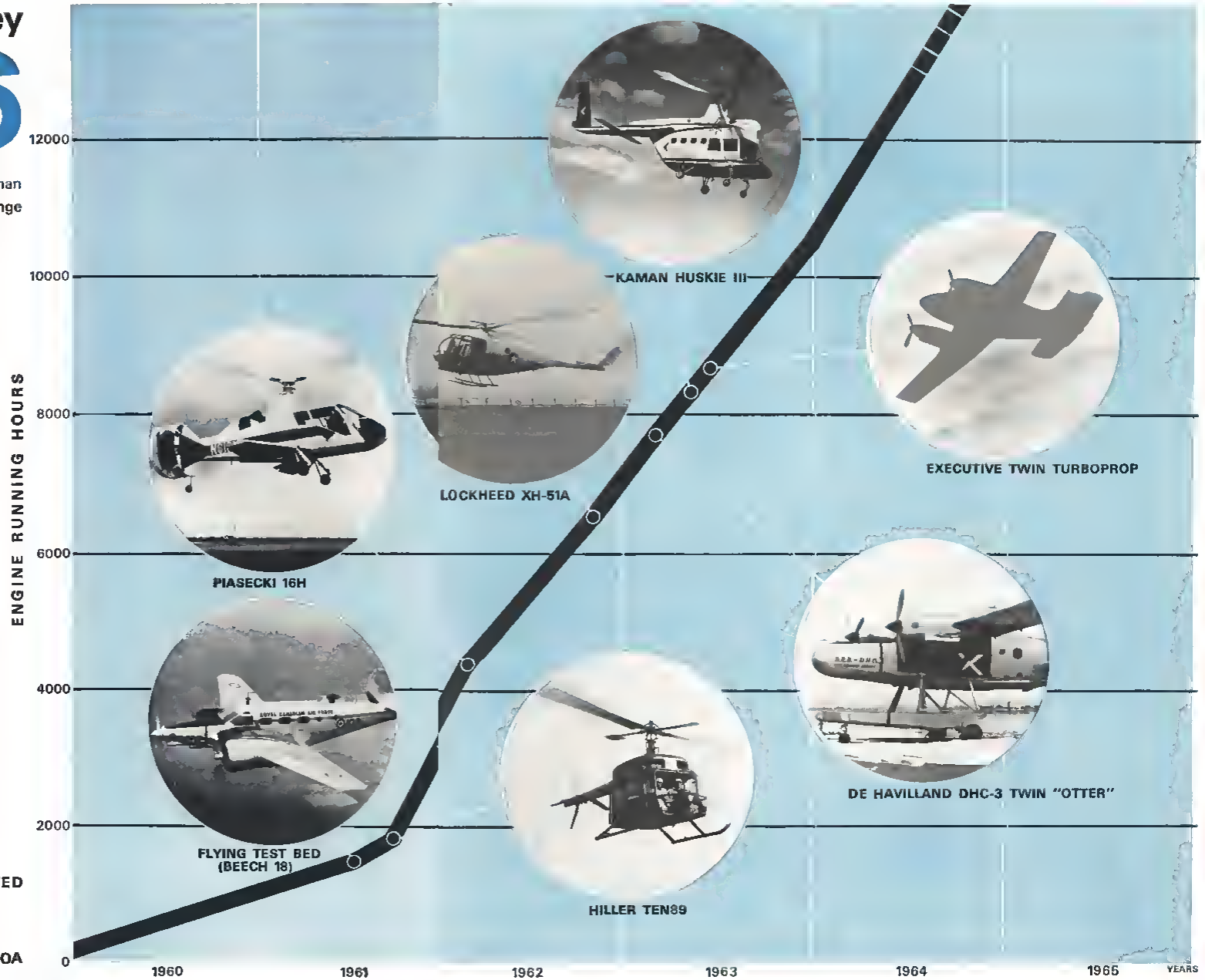
Helicopter service was viewed as a promotional factor for the fair, similar to the monorail tram used at last year's Seattle World's Fair. New York Airways was also counting on the shuttle operation as a major revenue source.



HELIPORT'S PROXIMITY to other skyscrapers, including the United Nations Building and the Chrysler Building (top) is evident although telescopic lens makes distances appear shorter. Dotted line (below) is approximate limit for rotor clearance from the pillbox terminal. Transparent dome above the terminal is the control tower. Ducts (center) are for the building's air conditioning system. Installation has begun of a convergent type vane that wind tunnel tests indicated would stabilize air flow within 15 ft. of the rooftop at velocities up to 100 mph. Pad is 122 ft. long, 84-133 ft. wide and 808 ft. above the street.

The Pratt & Whitney PT6

offers more developmental and in-flight hours than any competitive engine in the 500-700 H.P. range



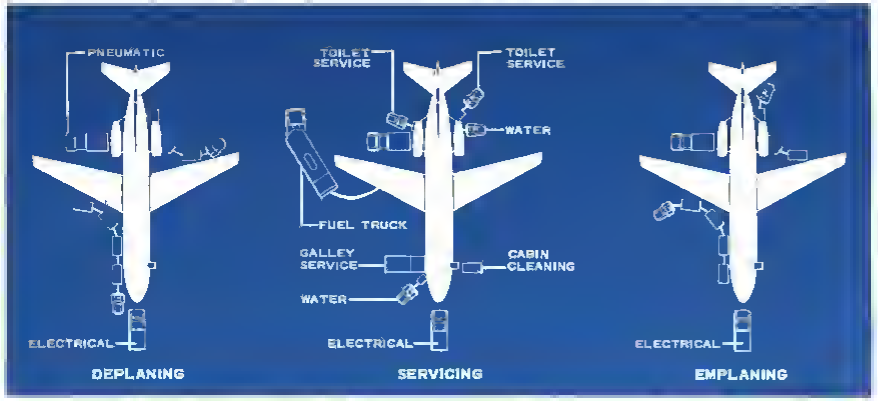
UNITED AIRCRAFT OF CANADA LIMITED

P.O. BOX 10, LONGUEUIL, QUEBEC, CANADA

Airline Traffic—March 1963

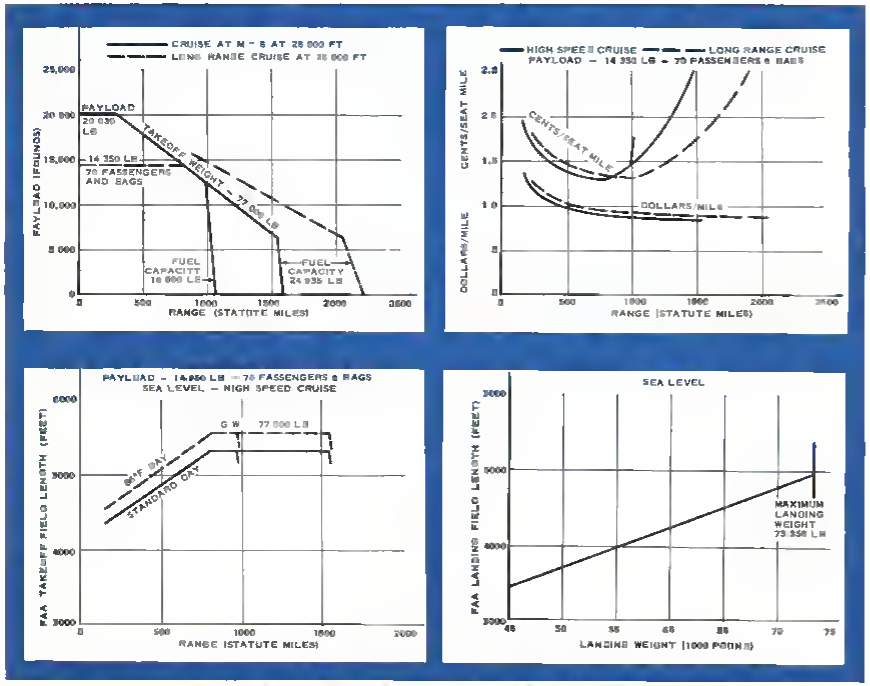
	Revenue Miles (000)	Originating Passengers (000)	Revenue Passenger Miles (000)	Revenue Passenger L/F (%)	Total Revenue Ton Miles (000)	Average Over-all Load (Tons)	Scheduled Miles (000)	Performance Factor (%)
DOMESTIC TRUNKS								
American	10,588	643 8	527,785	54 9	66,782	6 31	10,844	98 0
Braniff	2,609	203 4	97 368	52 1	11 103	4 26	2,642	98 1
Continental	2,228	126 4	86 693	45 4	9,843	4 42	2,253	98 4
Delta	5,338	400 4	263,683	59 8	29,411	5 51	5,477	97 1
Eastern	9,125	781 2	409 342	51 9	44 568	4 88	9,294	96 1
National	2,686	182 7	150,176	56 1	16,438	6 12	2,804	94 3
Northeast	1,652	130 6	77,034	60 2	7,974	4 83	1,777	90 9
Northwest	2,951	184 8	124 153	46 1	14 725	4 99	2,982	98 8
Trans-World	7 799	421 9	382 129	48 2	45,713	5 86	7 839	98 9
United	14 891	920 9	626,959	49 8	75 876	5 10	15,091	92 7
Western	2,131	204 2	110 025	52 6	11,436	5 37	2,174	97 8
Trunk Total	61,398	4,200 3	2,855,347	51 9	333,869	5 38	63,177	96 9
INTERNATIONAL								
American	160	11 7	12,791	73 4	1,620	10 13	160	100 0
Braniff	278	10 0	12,567	47 1	1,628	5 86	279	99 2
Caribair	178	59 9	4,591	58 5	478	2 68	172	97 4
Delta	109	2 1	3,322	36 1	417	3 85	112	96 9
Eastern	998	46 8	69,767	53 5	7,199	7 21	1,031	96 3
Mackey	110	13 0	2,223	34 9	224	2 03	109	99 7
Northwest	924	19 1	44,889	48 1	7 839	8 49	870	98 4
Panagra	339	12 7	20,846	64 3	3,000	8 84	337	97 8
Pan American	9,325	339 4	605 206	55 4	87,505	9 38	8,777	98 2
South Pacific	16	0 2	508	37 8	53	3 21	16	100 0
Trans-Caribbean	238	13 2	24 348	63 7	2,475	10 36	181	100 0
Trans-World	1,949	32 1	104 292	43 5	16 373	8 40	1,905	99 5
United	555	16 0	38 961	60 6	4,935	8 90	557	99 5
Western	189	7 7	11 841	65 2	1,279	6 77	189	100 0
International Total	15 368	583 9	957 092	53 8	135 025	8 79	14 695	98 4
LOCAL SERVICE								
Allegheny	931	80 9	16,822	39 5	1,783	1 92	993	92 8
Bonanza	514	45 8	11,993	61 3	1,194	2 32	515	99 6
Central	604	30 5	6,242	37 3	657	1 09	602	98 6
Frontier	975	37 5	10,697	35 0	1,144	1 17	986	98 4
Lake Central	531	35 6	5,613	36 7	594	1 12	570	92 0
Mohawk	917	93 0	19,160	46 6	1,958	2 14	966	91 0
North Central	1,203	84 8	14,756	37 6	1,598	1 33	1,232	96 0
Ozark	856	61 2	11,522	46 4	1,218	1 42	882	96 8
Pacific	453	42 1	8,997	47 2	892	1 97	454	98 3
Piedmont	898	62 4	14,190	40 9	1,482	1 65	908	98 1
Southern	830	44 5	8,463	33 3	896	1 08	850	95 8
Trans-Texas	671	34 8	8 218	40 0	873	1 30	681	98 2
West Coast	599	30 0	7,316	37 8	738	1 23	594	99 6
Local Service Total	9 982	883 1	143 989	41 5	15 825	1 51	10,233	96 3
ALASKA & HAWAIIAN								
Alaska Airlines	250	6 1	4,461	31 4	1,076	4 30	142	91 9
Alaska Coastal	120	7 8	585	50 5	74	0 61	91	93 4
Aloha	188	27 0	3,996	59 7	328	1 98	171	93 5
Cordova	61	2 3	465	51 0	76	1 25	37	96 0
Hawaiian	248	35 5	5,269	53 3	570	2 29	258	87 3
Kodiak	19	0 7	33	28 7	4	0 23	13	99 0
No. Consolidated	144	2 7	841	36 1	198	1 38	100	92 0
Pacific Northern	348	9 3	7,549	22 3	1,417	4 07	348	98 6
Reeve Aleutian	89	1 5	992	26 8	270	3 05	81	80 0
Western Alaska	26	0 7	36	65 5	6	0 22	16	93 8
Wien Alaska	274	3 7	1,077	25 5	459	1 67	130	89 2
Alaska & Hawaiian Total	1,745	97 3	25,304	32 8	4,478	2 57	1,387	92 3
HELICOPTERS								
Chicago	25	4 2	84	34 0	8	0 34	29	83 8
Los Angeles	70	12 7	513	42 1	57	0 82	72	95 9
New York	38	18 8	375	41 1	39	1 00	44	80 6
Helicopter Total	133	35 7	972	40 9	104	0 78	145	88 8
CARGO & OTHERS								
Aeravias				Not Available				
Avalon	31	7 3	377	56 9	37	1 16	8	97 2
Flying Tiger	939	2 9	11,077	88 2	12,929	13 77	462	100 0
Riddle	865	2 4	10,941	93 0	5,999	6 94	191	94 2
Seaboard	590	5 5	21,143	95 6	9,774	16 56	396	89 3
Slick	485	0 1	145	12 4	4,362	9 40	172	95 5
Cargo & Other Total	2,910	18 2	43 883	91 8	33 301	11 44	1,229	95 0
Industry Total	92,136	5,818 5	4,026,387	51 9	521,802	5 66	90,866	96 3

Prepared by Gay & Gay

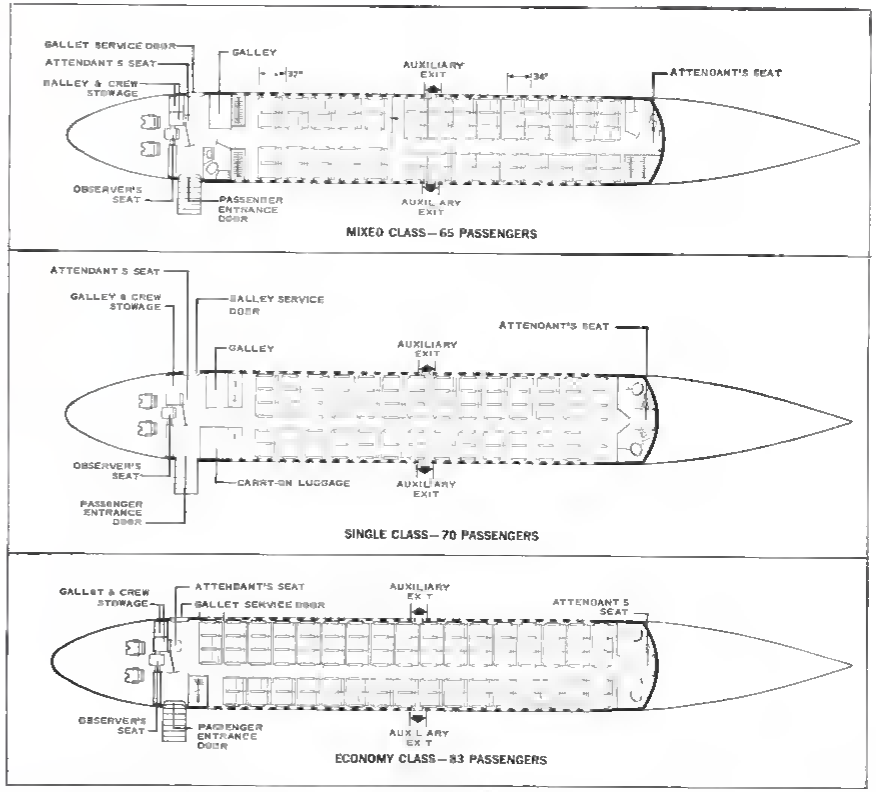


Ground support equipment for the Douglas DC-9 is basically the same as that required for larger jets. Aircraft is designed for 10 min. ramp time at station stops—15 min. when refueling is required—and 30 min. turn-arounds at route termination points. Idling right engine at stops en route eliminates need for ground power. Optional auxiliary power unit adds 540 lb. to weight-critical rear area.

DC-9 Design, Performance Projections Shown

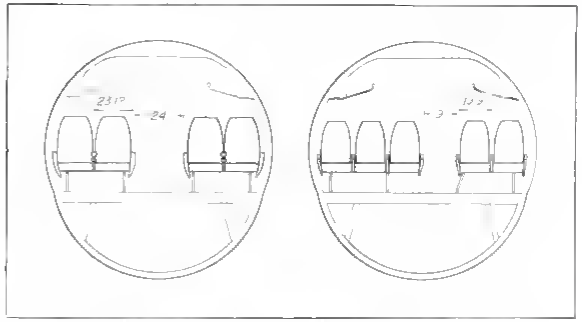


Increased performance and payload is evident in figures revised upward from original DC-9 estimates (AW Jan. 22, p. 48). Increases are largely result of airline requests for more versatility. Longer range version would carry center-section fuel.



Three seating configurations for the DC-9 are offered. Most carriers considering the aircraft reportedly favor 70 passenger single class or 65 passenger mixed-class arrangements. Note special area for carry-on luggage in middle drawing; single-class being aimed primarily at business travelers. Aircraft is designed for two pilots but has space for flight engineer.

Different engine than the one originally proposed will be used on the Douglas DC-9 as a result of size increases that give the current version about 83,000 lb. gross weight compared with 69,000 lb. under the initial plan. Pratt & Whitney JT8D-5 powerplants will provide 12,000 lb. of thrust per engine, 2,000 lb. more than the P&W JT10A-2 first planned. Aircraft has been designed toward minimum landing weight limitations to facilitate short-segment operation without frequent refueling. On shorter range DC-9 version (AW Apr. 15, p. 41) maximum landing weight is 73,350 lb., compared with maximum takeoff weight of 77,000 lb. Single passenger door has a self-contained stairway eliminating need for portable ramps at all stations. Swing-down door is also considerably simpler than those on larger jets. Two cargo bays are provided and offer 365 cu. ft. in the forward unit and 235 cu. ft. in the aft.



Proposed seating width would give passenger 19.9 in. between centers of arm rests on five-abreast seats. Douglas has recommended a seat design for the aircraft, but will subcontract actual seat construction.

AER LINGUS IRISH INTERNATIONAL

chooses BAC ONE-ELEVEN

Mr. J. F. Dempsey, General Manager of Aer Lingus says:

"Aer Lingus has chosen the BAC One-Eleven as the aircraft most suited to our requirements for a fast economical and comfortable jet transport over our European routes . . .

The One-Eleven is in our opinion the most advanced short haul jet. On inter-city routes it will offer performance and passenger comfort equal to 'big jet' standards . . .

Provision for future all weather blind-landing aids is built into the design of the One-Eleven and this was an important factor in our evaluation . . .

We believe that in its particular field the One-Eleven represents a marked improvement on all other available equipment and we are satisfied that the maker's claims in this respect are well founded."

BAC

JET SUCCESSOR TO THE VISCOUNT WITH EVEN BETTER THAN VISCOUNT ECONOMICS

ONE-ELEVEN

TWO ROLLS-ROYCE SPEY TURBOFAN ENGINES

THE SHORT HAUL JET

BRITISH AIRCRAFT CORPORATION

ONE HUNDRED PALL MALL LONDON SW1 ENGLAND
USA BRITISH AIRCRAFT CORPORATION (USA) INC.,
399 JEFFERSON DAVIS HIGHWAY ARLINGTON 2 VIRGINIA

AER LINGUS
IRISH INTERNATIONAL AIRLINES

BAI 20

AIRLINE OBSERVER

► Although still burdened by deficits, Trans World Airlines' recent traffic growth recovery, which has already forced a revision in the terms of its merger agreement with Pan American, is attracting close industry attention. Domestic traffic volume is growing steadily and the airline is forecasting a 25% improvement in international revenue miles for 1963 over last year.

► Transportation industry is tacitly supporting Miss Frances Knight, director of State Dept.'s passport office, in the current dispute over alleged attempts to remove Miss Knight from her post. Although the industry has not taken a public stand because of the political implications, a number of industry officials are annoyed over reports that Abba P. Schwartz, administrator of the bureau of security and consular affairs, plans to reorganize the passport office as a means of eliminating Miss Knight.

► Eastern Air Lines' President Malcolm A. MacIntyre found an analogy between the federal government's guidelines for mergers and "Russian Roulette." During the Air Transportation Symposium conducted by Connecticut General Life Insurance Co., MacIntyre noted that the government had explained that all 11 guidelines did not necessarily have to be met, but there had been no mention of which one could be ignored. Thus, he said industry has only "to shoot the bullets and find which chambers are empty."

► Russia is attempting to coordinate air, rail, bus and river boat schedules to minimize layovers at points where passengers change from one mode of transportation to another. The move is aimed primarily at facilitating tourist travel and follows Pravda's publication of complaints against poor connections. Meanwhile, Aeroflot is also inaugurating a number of direct air services from smaller Russian cities, including Arkhangelsk, Chelyabinsk and Kemerovo, to the nation's largest southern resort areas—Sochi, Simferopol and Mineralnye Vody.

► Trans World Airlines has received Federal Aviation Agency certification of its auto-thrust system, an automatic throttle control linked to an angle of attack monitor called speed control-attitude target (SCAT). System automatically adjusts power for optimum performance of all speeds and attitudes, relieving pilots of having to fly by airspeed reference. TWA may install system on its entire jet fleet, depending on availability of funds.

► FAA Administrator N. E. Halaby has indicated that the current regulation requiring a three-man flight crew on all transport aircraft weighing more than 80,000 lb. may not be used as an exact criteria in determining crew complements on future transport aircraft. Halaby said at the Connecticut General symposium that the regulation can be modified to cover aircraft larger than 80,000 lb. as long as two men can operate the plane safely. R. V. Carleton, senior vice president of Braniff, which has purchased the 73,500-lb. gross weight BAC 111, commented he did not like to see the rule changed after Braniff had made its equipment decision. The Douglas DC-9 will have a 77,500-lb. gross, but a long-range version, with a center section fuel tank, will hit 83,000 lb.

► Total outstanding short interest in National Airlines common stock dropped from a peak of 137,625 shares in mid-April to 98,232 in mid-May. The drop coincides with conversion of about $2.5 million in National's $10 million issue of convertible debentures into 168,000 shares of stock following the May 1 interest payment date. The debentures are convertible at one share for each $15 worth of debenture. In early May, common stock was selling at $30. Traders have run up the short interest total by speculating on price differences between the common stock and the price based on purchase and subsequent conversion of debentures (AW Apr. 1, p. 49).

► Five bidders, including a British firm, have submitted proposals to FAA for its program to design an airborne low-weather minimum automatic landing system to be installed in a jet transport for FAA flight tests (AW Apr. 29, p. 76). Bidders are Lear Siegler, Honeywell and the British Smiths Aviation, Ltd., and the teams of Boeing-Bendix and Douglas-Sperry.

SHORTLINES

► Aeroflot expects to have twin-jet Tu-124s in service on at least 56 medium-range domestic routes this summer. The 44-passenger Tupolev transports first went into regular operation last November.

► Delta Air Lines reported a net income of $1,579,000 for April, compared with net earnings of $1,151,000 in the same month last year. No profits from the sale of aircraft were included in last month's report, but the April, 1962, net earnings included profits of $261,000 from that source.

► Federal Aviation Agency and Interior Dept. have signed an agreement under which an airport serving Yellowstone National Park will be built for general aviation and local service operations.

► Japan Air Lines reported a net deficit of $7.8 million for the fiscal year ended Mar. 31, despite 25% higher revenues than in the preceding fiscal year. High expenditures for new equipment and route expansion were given as basic reasons for the loss, the first deficit reported by the carrier in eight years.

► Mohawk Airlines will inaugurate service between Toronto and Boston next month via Buffalo, Rochester, Syracuse, Utica and Hartford. Service has been approved by both the Civil Aeronautics Board and Canadian Air Transport Board.

► National Airlines last week began issuing discount books to passengers traveling to Miami from New York, Philadelphia, Boston and Providence. Books contain 55 coupons providing discounts ranging from 5% to 20% at shops and restaurants in Miami Beach.

► Northwest Orient Airlines is converting four Douglas DC-7 transports to an all tourist configuration to accomodate summer vacation travel from the east and midwest to dude ranch areas of Montana and adjoining states.

► Pan American World Airways first-quarter operating revenues totaled $115.3 million, compared with $102.6 million in the same period last year. Net loss after taxes was $2.2 million, compared with $4.6 million a year previously.

► Varig Airlines of Brazil has initiated once-a-week cargo service, using a Lockheed 1049H Constellation, between Miami and Porto Alegre via Santo Domingo, Belem, Rio de Janeiro and Sao Paulo.

STARTING SEQUENCE of Rocketdyne F-1 engine shows small LOX boiloff (left and center) as plumbing is chilled. Main vent is closed

(p. 48, right) as wind splits LOX cloud. Engine is run at full thrust (above), creating water vapor cloud from flame deflector cooling system

Instability Absent in Recent F-1 Engine

By C. M. Plattner

Los Angeles—Combustion instability problems experienced in development of Rocketdyne's F-1 1.5 million lb thrust, liquid-fueled rocket engine continue to pose the most serious obstacle in preparing it for preliminary flight rating tests (PFRT) late this year.

First F-1 production engine is scheduled for delivery to National Aeronautics and Space Administration's Marshall Space Flight Center in October. Qualification and first flight are scheduled in 1966. NASA has insisted that every effort be made to eliminate combustion instability, as much as possible, prior to the PFRT.

Clustered in a group of five, the F-1 engines will power the first stage of the Saturn 5 launch vehicle for the Apollo manned spacecraft.

Extensive research and engineering efforts by NASA and Rocketdyne on the combustion instability, also called combustion oscillation, are reported to be paying off. Both frequency of occurrence and severity of the instability have been reduced in a recent series of tests, according to Rocketdyne.

In the latest test series of more than 40 full-thrust, varying duration engine tests using a modified injector, no evidence of instability has been recorded. This test series, as well as a better understanding of F-1 combustion through related research, has produced optimism at NASA and Rocketdyne that the problem can be resolved, although both organizations admit that considerable work must still be done.

Top level NASA decision is expected this summer on starting F-1 production with the latest injector modification to meet the scheduled October delivery. This decision will involve determining whether limited testing on the latest modification, if no instability problems arise, is a sufficiently firm basis for beginning production.

Combustion instability has occurred in eight of more than 310 tests of the F-1. Seven occurrences in 250 tests were reported by S. K. Hoffman, Rocketdyne president, to the manned space flight subcommittee of the House Science and Astronautics Committee Mar. 18 during hearings on the problem.

Hoffman also said at the hearing that starting reliability in a recent tests series was 99%. Over-all starting reliability figure is approximately 95%, with shutdown reliability closely approaching or bettering that figure.

Opinions have varied on the relative importance of F-1 instability in the early part of the development program, which now is roughly at its midpoint. Rocketdyne feels the problem has been more severe than in other engines it has developed, including Atlas and Thor missile engines, which later established excellent reliability records.

Rocketdyne's original approach to building the F-1, accepted by NASA, was that the engine be man-rated before the first manned flight. Soon after the start of full-thrust engine tests at the Edwards AFB, Calif., high-thrust test area early last summer, however, NASA became concerned with the instability problem. Two teams of NASA propulsion specialists were formed (AW Feb. 4, p. 26) in mid-summer of 1962 to help resolve the problem. Both teams are still active.

NASA's insistence on removing combustion instability has resulted in higher reliability requirements in early stages of development than ever before established for a new engine. To meet these demands, Rocketdyne is devoting roughly one-sixth of its total F-1 engineering effort to the combustion instability problem. Approximately 175 engineers and scientists from within the company are assigned to the job working primarily on analysis and design.

Difficulty in coping with the instability problem stems mainly from the lack of basic knowledge of the phenomenon and the pitfalls of extrapolating smaller engine technology to a large engine like the F-1.

The solution to the instability problem in the past generally has entailed modification and testing. Frequently, the injector was modified and then tested to verify the fix. If the engine worked successfully, it was fixed. If not, other modifications were evolved. Shape and size of the thrust chamber have also been varied to help eliminate instability, although no change in the general geometry of F-1 chamber has been made.

Rocketdyne is now evaluating baffling systems such as those used on the Atlas engine, to reduce tangential instability, a shock wave propagated around the perimeter of the thrust chamber. The wave front is created by a local disturbance, sometimes a variation in burning rate. Baffles break up the wave front as it attempts to follow the periphery of the chamber around to its point of origin, or intermittent sustainer points.

Without the baffles, if the shock wave arrived at the right time it would be boosted rather than attenuated by the local explosive burning of fuel and oxidizer which had accumulated during the time it was traveling around the edge of the thrust chamber. This would result in a continuing cycle of increasingly large amplitude pressure oscillations within the chamber.

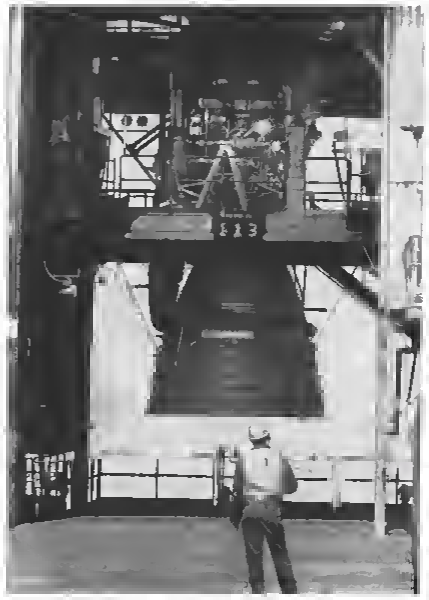
Shock wave also acts as a diffusing mechanism, providing better mixing of fuel and oxidizer, with attendant high burning temperatures. Hot spots are formed when the shock wave penetrates through the cooler, outer boundary layer and contacts the chamber wall. If the engine is not shut down, complete burnthrough usually occurs.

Other basic forms of combustion instability, transverse—oscillation back and forth along the radial axis—and longitudinal—parallel to the thrust axis—have been experienced at different times with different F-1 injectors. Transverse oscillations have occurred most frequently in F-1 development, and research is being conducted on other hot gas suppressors to eliminate this problem.

Modification of the injector has been

Test Series

F-1 ENGINE is shown on two-engine test stand at NASA's High Thrust Test Area



CLOSE-UPS OF F-1 engine show vertical pipe (left) which ducts exhaust from gas turbine and bleeds it into interior of exit nozzle for boundary layer cooling. Feed manifold (right) consists of upper horizontal liquid oxygen line and lower kerosene line.

the basic approach to solving the F-1 instability problem. The injection system has been described as a flat plate with about 6,000 metering holes in groups of three to form a single liquid oxygen fan and in groups of two to form a single kerosene fan. The size and location of the metering holes have been varied in an effort to obtain stable combustion.

Injector systems are fabricated by Rocketdyne to production tolerances eliminating a possible future problem encountered in switching from finely machined, hand-made units to production line tolerances. By following this procedure Rocketdyne feels once a final design is decided on, the problem of instability is not likely to show up in production engines.

Since combustion instability occurs at random, Rocketdyne has induced combustion vibration in all F-1 thrust chamber tests for the last four months by using the "bomb" technique. This method used successfully in previous engine development programs helps produce instability for test observations. It also indicates whether an engine is inherently stable—one requirement for manned flight.

Technique involves detonating a charge of powder inside the thrust chamber to induce an artificial shock wave. During F-1 thrust chamber tests, the shutdown sequence is started at same time. A built-in delay in that system allows sufficient time for test observations and prevents serious chamber damage.

Powder charges varying from 13 to 200 grams have been used to date in tests, but the size of charge and the point where it is detonated apparently have little effect on the engine's ability to recover from the explosion, according to Rocketdyne.

Instability induced by "bombing" generally has dampened out, but in varying increments of time depending on injector configuration. Some oscillations have become increasingly worse, indicating an unstable configuration. These cases, however, represent a relatively small part of the total tests, Rocketdyne says.

No bomb tests have been made on chambers fitted with the recently modified injector because of previous scheduling commitments.

Rocketdyne is preparing to run a bomb test on a complete engine to ensure that thrust chamber tests duplicate the results achieved with a unit having an exit nozzle.

Other analytical efforts being employed by Rocketdyne to study instability are an extensive review of results of past tests and an increase in instrumentation on current tests. High-speed cameras, capable of 5,000 to 8,000 frames per second, also are being used to record the combustion process through windows in the thrust chamber wall.

Over-all reliability established by the F-1 in the development program to date is approximately 70-75%, according to Rocketdyne.

This figure includes consideration of all reliability factors connected with the engine, including combustion instability, components malfunction and engine performance.

Development of primary components for the F-1, as well as system operation, is progressing satisfactorily, according to observers.

Three new stands for testing production engines are being constructed at the Edwards high-thrust test area, and work should be completed by May 1964. Cost of the test stand project is estimated at $30 million.

Construction of the first stand will be completed by November and the stand should be operational in January, 1964. The last of the three stands will be an environmental test version. Three test stands now are in use at the Edwards facility—two for engine testing and one for thrust chamber testing.

Lunar Landing Abort Techniques Studied

By Erwin J. Bulban

Dallas—Procedures and instrument displays that would be required by Lunar Excursion Module (LEM) crew to handle an abort situation while the vehicle was enroute to a landing on the moon are being studied here by National Aeronautics and Space Administration astronauts in Ling-Temco Vought's moving base simulator.

Study program thus far has assumed that the LEM's primary guidance system has failed during the vehicle descent to the lunar surface and that the astronauts will be required to use manual control to abort the landing, intercept and rejoin the lunar orbiting command module for return to earth.

Under a $100,000 contract from NASA's Manned Spacecraft Center, Houston, Tex., the astronauts have been using the fixed-base simulator (AW Jan. 15, 1962, p. 77) to evaluate several approaches to intercepting and rejoining the command module.

Abort Conditions

Factors such as relative positions of the LEM and command module at the time of abort, the rendezvous time required and the LEM's fuel situation are being considered.

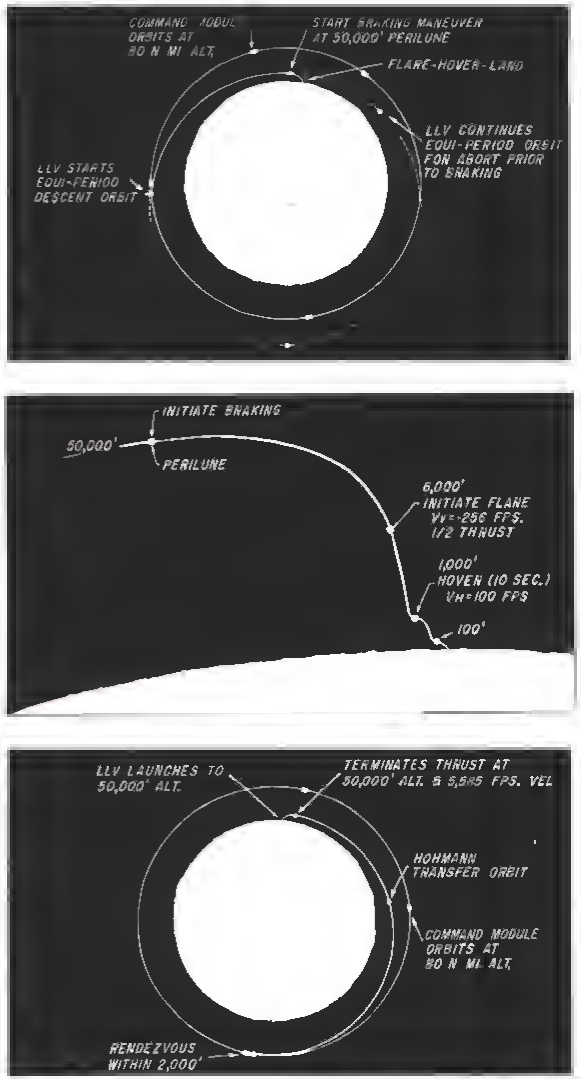
The simulated situations mainly covered separation of the LEM from its landing platform prior to touchdown on the lunar surface. Some simulations also have been made of separation immediately after touchdown and at various time intervals after touchdown.

From simulations conducted there seems no doubt that an astronaut can manually accomplish the landing abort, launch and intercept mission in event of LEM primary guidance system failure, according to A. D. Schaezlein, L-T-V Astronautics Div. project engineer on the study. NASA project engineer is D. C. Cheatham of MSC's Spacecraft Technology Div.

Astronaut Participants

Astronauts who have participated in the studies thus far include, M. Scott Carpenter, Walter M. Schirra, Jr., and astronaut-candidates Neil A. Armstrong, James A. McDivitt, Elliott M. See, Jr., Charles Conrad, Jr., John W. Young and Edward H. White, II.

These studies follow numerous similar studies made by L-T-V on its simulator. A typical lunar landing vehicle maneuver, covering trajectory and guidance control aspects practiced by L-T-V personnel is based on a command module moon-orbit of 80 naut. mi. altitude; an equi-period descent of the LLV to



EQUI-PERIOD ORBIT TECHNIQUE, top, could be used by lunar landing vehicle (LLV) to make approach to landing site. LLV descent is shown in center photo. Bottom is launch from the lunar surface and rendezvous with the command module, utilizing the Hohmann transfer orbit technique

ASTRONAUT WALTER M SCHIRRA, JR, checks out L-T-V simulator's information displays prior to simulated Lunar Excursion Module abort practice flight

the surface The orbit of the moon is made by the command module to set up the separation point for the lunar lander on the following orbit to permit an equi-period descent orbit for the landing vehicle

This entails separation of the LLV from the command module at the three-quarter point using translation jets

The crew, in simulated flight, rotated the landing vehicle so they were head down and facing forward Reaction thrusters were then fired to obtain a 372 fps delta velocity The velocity was directed downward and 2·3 deg rearward, preserving some of the total forward velocity while changing the LEM's orbit

The equi-period orbit technique is designed to put the landing vehicle in an orbit with a perilune of approximately 50,000 ft near the landing point and an apilune of approximately 152 naut mi

Should the main descent engine fail to ignite for the final landing phase, the lunar lander would then coast toward interception of the command module's orbit

Landing Sequence

Approaching perilune, the simulator crew again re-oriented the lander so that the thrust axis was horizontal with the crew facing rearward and upward-The retrorocket was fired at the point of perilune, which is approximately 170 190 mi from the final touchdown point

The vehicle then was tilted constantly so that the thrust vector was maintained along the descent trajectory Flareout would be initiated about 1,000 ft above the lunar surface and ahead of the landing site until hover is initiated and the vehicle is maneuvered to actual touchdown

Flight from perilune to touchdown as practiced in the simulator, consumed approximately 5-6 min

Lunar Takeoff

Simulated takeoff and return to the orbiting command module was begun when the command module was some 10 mi past the lunar lander Flight path followed an altitude and velocity schedule designed to accelerate the lunar lander to circular speed at approximately 50,000 ft

After takeoff the astronaut maintained a decreasing vector of thrust, keeping the thrust vector aligned with the velocity vector By the time the vehicle reached simulated circular speed —5,555 fps—the thrust vector was aligned horizontally

As it accelerated through circular speed to Hohmann transfer speed—5,585 fps—the astronaut tilted the thrust vector slightly downward to maintain a constant altitude

Upon passing circular speed and at taining Hohmann transfer speed, which is a rapid transition lasting about 1½ sec, thrust was terminated and the lander coasted on the Hohmann transfer orbit to intercept the orbit of the command module

At the time the lander attained Hohmann transfer speed it was some 200 mi behind the overhead orbiting command module

AFOSR Awards

Air Force Office of Scientific Research recently awarded grants and contracts totaling approximately $2 million to universities and research firms in the United States and Europe.

Grants

University of Illinois, Urbana Ill—$83,718 for study of problems related to optical communications.

University of Michigan Ann Arbor, Mich—$10 895 for investigation in the theory of spheroidal and mathieu functions.

Columbia University New York N Y—$47 106 for control systems research program $85 897 for basic problems in dislocation theory

Northwestern University Evanston Ill—$42,000 for research in the design of pulse-width modulated control systems and pulse-frequency modulated control systems $109,968 for research on phase transformation and precipitation studies in ceramics.

California Institute of Technology Pasadena Calif—$20 000 for mathematical investigations of problems in dynamics of fluids and of rigid bodies

University of California Los Angeles, Calif—$38 809 for study of high precision geocentric and interplanetary orbits

Princeton University Princeton, N J—$28 068 for research in harmonic analysis and its relationship to theory of probability $23 732 for research on physiological stress in relation to innate daily Rhythms

Texas A & M College Station Tex—$31 578 for the study of electronic spectra of simple molecules

Cornell University Ithaca N Y—$78,347 for theoretical research in astrophysics $27 205 for investigation of inelastic molecular collisions $41 120 for study of the metabolism of carbon dioxide photosynthesis

University of Canterbury Christchurch New Zealand—$28 900 for research in gaseous reactions

University of California Berkeley Calif—$60 835 for research in spectroscopic and theoretical studies of molecules $51,202 for study of comparative national development

University of Chicago Chicago Ill.—$89,384 for studies in theoretical chemistry, $15 504 for investigation of the application of information theory to the nervous system $40 431 for study of transport properties of partially ionized gases

Kansas State University of Agriculture & Applied Science Manhattan, Kan—$32,003 for research in crystallography of solid nitrogen oxides.

Communication Research Institute Miami, Fla—$46 920 for communications studies on tursiops truncatus and other dolphinids

University of Pittsburgh Pittsburgh Penn.—$16 707 for investigation of flash spectroscopy and flash fluorimetry in photosynthetic studies.

University of Georgia Athens Ga—$36,556 for study of equalization of inadequate symbolic configurations

University of Massachusetts Amherst, Mass.—$25 423 for study of the effects of unusual environmental factors on human performance

Polytechnical Institute of Brooklyn Brooklyn N Y—$37 150 for research on plates and shells under external loading and elevated temperatures

California Institute of Technology Pasadena Calif—$75 941 for investigation of nonlinear problems in structural dynamics.

Johns Hopkins University Baltimore, Md—$20 520 for the study of thermal effects in solids

University of Toronto Toronto Canada—$5 351 for study of aerophysical problems at hypervelocities $12 895 for research in plasma dynamics and magnetogasdynamics

Contracts

Grumman Aircraft Engineering Corp Bethpage N Y—$67 500 for research in opti-

How Goodyear "Engineered Value" solves tough flight problems

FOR LIGHT PLANES

PROBLEM: Better, lower-cost braking.
SOLUTION: "Ring Disc" wheels and brakes.

"Engineered Value" Advantages: Longer lining life. Permit tire change without necessity of brake removal. Lower brake pedal loads. Resist brake fade. Structurally fail-safe. Provide visual wear indication.

FOR AIRLINES

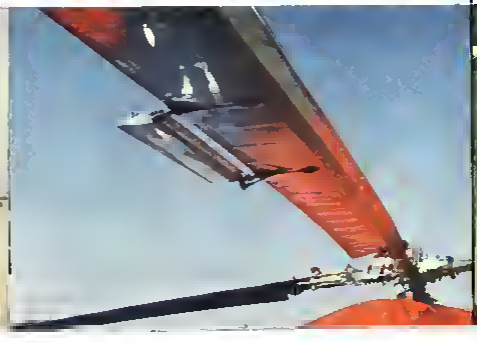
PROBLEM: Short jet tire life.
SOLUTION: "Red Streak" Jet Tire.

"Engineered Value" Advantages: Up to 15% more landings per tire. More rubber at wearing surface. Shredded wire shield resists cuts and cut growth. Has built-in wear indicator. Assures more retreads.

FOR THE NAVY

PROBLEM: Helicopter rotor deicing.
SOLUTION: Iceguard.

"Engineered Value" Advantages: Most efficient type of ice removal. Provides uniform heat, no hot spots, no cold spots. Has no effect on airfoil surface or balance. Has no moving parts. Lightest weight.



FOR THE AIR FORCE

PROBLEM: Heat-shield missiles.
SOLUTION: Goodyear Thermal Shield.

"Engineered Value" Advantages: Withstands 6,000-7,000°F-ablating environments for 60-90 seconds. Takes gas speeds on surfaces up to Mach 1. Below: 5,000-ton press and missile liner molding equipment.

"Engineered Value" is a Goodyear exclusive. It means *extra value* in products developed through the unmatched capabilities of one of the world's largest, most experienced manufacturers of aircraft components—Goodyear. Since Kitty Hawk, Goodyear scientists, engineers and researchers have been solving flight problems with "engineered value" products. They stand ready to solve your problems, too. For full information write Goodyear, Aviation Products, Dept. E-1715, Akron 16, Ohio.

GOODYEAR
AVIATION PRODUCTS

THE DANGEROUS BABY

LEACH HERITAGE OF THE AIR—28

The Summer of 1915 was tough on the Tommies dug in along the Belgian front near Ypres. The Germans were peppering the British trenches with deadly accurate shell fire. And the enemy artillery batteries were well-hidden.

To find something for the British to shoot at, a call went out to the Royal Flying Corps for aerial scouting.

One of the favorites of the R.F.C. was the Bristol Scout. Even by 1915 standards, the plane was tiny. Sometimes called the Bristol Baby Biplane, it was a mere eight and a half feet high, 20.8 feet from prop to tail, with a wing span of only 24.7 feet.

But the Bristol Scout, powered by an 80 h.p. Clerget or Le Rhone rotary engine, could outmaneuver anything the Germans had at that time. Fully loaded, it weighed a little over a thousand pounds and could climb at the rate of 880 feet a minute and reach 10,000 feet in 27½ minutes.

Because the little single-seater was used as a spy in the sky, there was no provision for armament. While most German reconnaissance planes carried a machine gun, the Bristol Scout was only occasionally fitted with a Lee-Enfield rifle, minus the stock, attached to the right side of the fuselage.

The observer in a German plane could swivel his machine gun and fire in almost any direction. The pilot of a Bristol Scout could fire his rifle only 30 degrees to the side and down from the line of flight—and without a sight.

The only other armament was a Mauser pistol in the cockpit and five grenades carried in a rack fixed to the right side of the fuselage.

(The Bristol Scout also had the distinction of being the first land plane to take off from an aircraft carrier. On November 3, 1915 it needed only 30 feet to take off. But the plane couldn't land on the carrier. It had to be fitted with airbags to keep it afloat after ditching.)

Until the second Summer of World War I, Bristol Scouts and their German counterparts calmly passed each other on their reconnaissance missions. Occasionally, a pilot or observer of one plane would pop off at another with a rifle, pistol or shotgun. But it wasn't until someone realized that these aerial onlookers posed a real threat, that air to air combat began in earnest.

One of these someones was Captain Lanoe G. Hawker, twenty five-year old pilot of a Bristol Scout attached to Number 6 Squadron of the Royal Flying Corps in Abeele, Belgium. Already the holder of the DSO for his singlehanded raid in a B.E. 2c on the Zeppelin sheds at Gontrode, he was to become even more famous in a little Bristol Scout.

It was July 25, 1915. Flying a routine patrol over the Ypres salient, Hawker spotted a German two-seater. Ignoring the enemy's machine gun, he attacked and sent the plane scurrying for home.

Twenty minutes later, over the Houthulst Forest, he came upon another two-seater, aimed his Lee-Enfield rifle as best he could, hit the plane's engine and forced the German to the ground.

He climbed to 12,000 feet. There was a two seater Albatros below him. Hawker dived down out of the sun, his simple, clip fed carbine cocked and ready. One man and a rifle against two men and a machine gun. Hawker won.

As the Albatros went down in smoke and flame, it flipped over, dropping the observer like a bomb. On the dead man's clothing, British soldiers found the positions of four German batteries, one of which had escaped the prying search of aerial pilots for many weeks.

For his spectacular feat against almost impossible odds, Captain Hawker won the Victoria Cross—the first time England's highest honor was given for air-to-air combat.

Hawker played a leading role in one more famous air battle of World War I—a 20-minute duel to the death with the famous Baron von Richthofen, "The Red Knight of Germany." That was November 23, 1916. The last day of his life.

relaxation theory and aerospace applications.

General Electric Co., Philadelphia, Penn.—$41 864 for analytical research pertaining to trajectory problems.

Baird-Atomic Inc., Cambridge, Mass.—$49 6[illegible] for continuation of research on circularly polarized optical masers.

RIAS Div. Martin-Marietta Corp., Baltimore, Md.—$27 781 for research in photosynthesis.

University of Georgia, Athens, Ga.—$40 000 for research analyses in the life sciences.

Human Sciences Research Inc., Arlington, Va.—$27 571 for continuation of research analytic model for interrelating physical and social effects of air attack.

Bureau of Social Science Research, Washington, D.C.—$57 120 for study of self-management techniques for stressful conditions.

General Electric Co. Klag of Prussia, Pa.—$28 508 for research in direct measurement of the molecular velocity distribution function. $41 700 for investigation of high altitude shock wave structure.

AIRA, Inc., West Covina, Calif.,—$38,714 for research in energy absorbing structures.

Dr. Maurice A. Biot, New York, N.Y.—$11 400 for research in incremental and nonlinear theory of deformation of solids.

Space Sciences, Natick, Mass.—$25 785 for research on drag in rarefied gases.

Giannini Scientific Corp., Santa Ana, Calif.—$78 734 for study of toroidal plasma containment.

Rocketdyne Corp., Canoga Park, Calif.—$[illegible]5 2 for research in calculations of the vibrational force constant.

United Aircraft Corp., East Hartford, Conn.—$74 [illegible]5 for study of non equilibrium ionization using electrostatic probes.

Dynamic Science, South Pasadena, Calif.—$14 143 for investigation of combustion instabilities.

Stanford Research Institute, Menlo Park, Calif.—$35 997 for continuation of research in individual information handling problems.

PRODUCTION BRIEFING

Defense Communications Agency will add automatic switching systems for voice, teletype and data communications among overseas installations and between the U.S. and these overseas points to modernize present defense communications system. Air Force will handle procurement of the automatic voice network (Autovon). Procurement agency for automatic digital network (Autodin) has not been determined at present.

Thiokol Chemical Corp. was awarded a $1.3-million contract to design, build and install a test section for the hypervelocity wind tunnel at Ames Research Center. The section will be used to investigate flight in planetary atmospheres and earth entry after completion of planetary flight.

First Sergeant tactical missiles have been delivered to the West German army in that country. West German units recently completed Sergeant training in the U.S. (AW Apr. 29, p. 67). U.S. Army in Germany also received the tactical missile at about the same time.

French government will establish a thermonuclear test center in the South

Pacific by 1966. Test base will be on the atoll of Mururoa, with rear support operations at Papeete, Tahiti, and an airstrip capable of handling large jets on the atoll of Hao, about 350 mi. northeast of Mururoa.

West German government plans to apportion about $7.5 million in aid this year among civil aviation programs—notably Hemkel's HB-211B turbojet transport and Hamburger Flugzeugbau's HFB 320 Hansa twin-turbojet executive aircraft. Total aid next year may grow to about $12 million.

Production of C-130 Hercules is expected to reach rate of 15 a month by the end of the year at Lockheed Georgia Co. First C-141 Starlifter is programed to be rolled out in August, with initial flight due before 1964.

Fairchild Stratos Corp. and Switzerland's Pilatus Aircraft Works, Ltd., are negotiating a licensing agreement under which Fairchild would produce 200 to 400 eight-place Turbo Porter utility aircraft during an initial three-year period.

Hiller Aircraft Co. has been awarded a follow-on contract for 137 OH-23G observation helicopters for the Army. First deliveries will be made during the latter part of the year. The additional buy is from funds appropriated for Fiscal 1963.

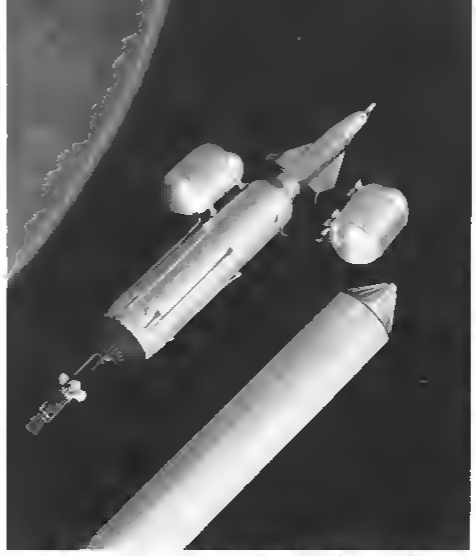
Lycoming Div., Avco Corp., has a $7.4-million Air Force contract for production of higher rated T55 gas turbine engines. Contract calls for an undisclosed number of 2,650-shp. T55-L-7 engines for Vertol CH-47B Chinook helicopters.

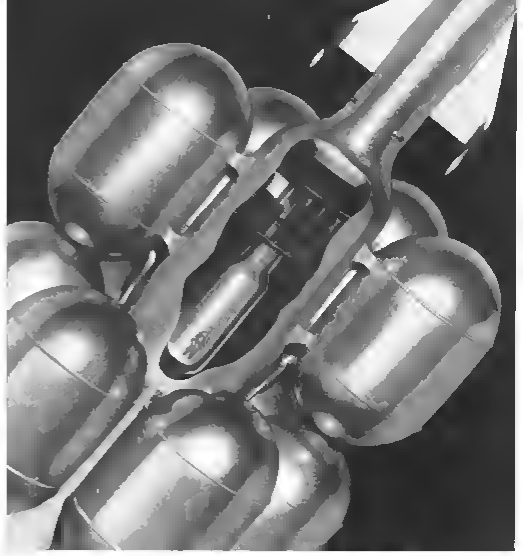
Bendix Field Engineering Corp. has received a $2 million incentive contract to furnish technical services for maintenance of parts depots and support of ground communications electronic equipment at mobile and fixed sites in Western Europe.

Aircraft Armaments, Inc., Cockeysville, Md., has a $1.8 million award for additional work on production of training simulators for the Army's Nike-Hercules anti-aircraft missile. Three principal improvements will be covered by the contract: increased capability, engineering and field service documentation, and an early production model of the complete system to be used later this year.

International Telephone and Telegraph Corp. has broken ground for a $3.5-million unit of the ITT Electron Tube Div. near Easton, Pa.

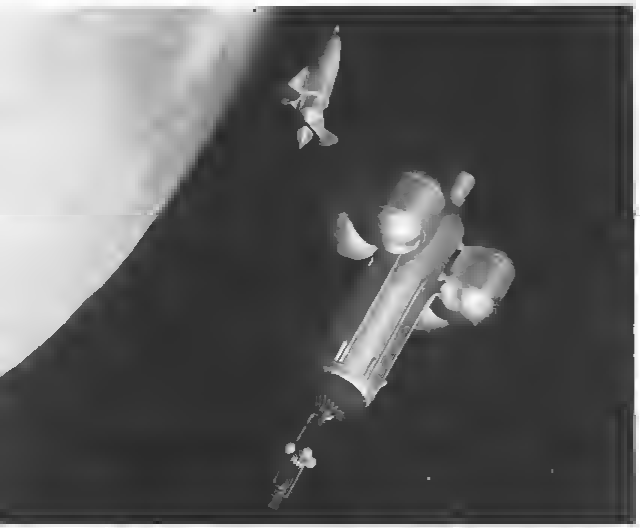
Propulsion payload module of the General Electric Mars manned vehicle, above left, has a winged Mars excursion module forward of the tank. Vehicle is designed to land two men on the surface of the planet. Three tanker vehicles, above right, would each carry four 45,000-lb. tanks of liquid hydrogen, would be launched to rendezvous with the basic vehicle.





Fuel tanks are attached to the propulsion module in earth orbit, above left. The nuclear powerplant uses a fast spectrum refractory metal core, considered promising for multiple re-start and clad erosion resistance qualities. Two-deck command module, above right, shows crewman in a solar flare storm cellar, lined with carbon shielding.

General Electric Proposes Nuclear-Powered Mars Vehicle for 15-Month Manned Landing Mission

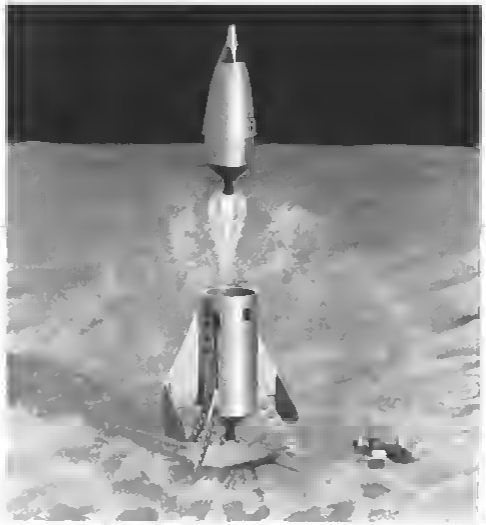


Excursion vehicle descends toward the Martian surface with all but four fuel tanks expended and jettisoned. Six tanks would be emptied to achieve a transfer ellipse. En route, the chemically propelled excursion module functions as an emergency escape vehicle.

General Electric Missile and Space Div. has conducted in-house studies of a manned Mars landing mission, illustrated in the accompanying photographs of a model built to support the studies. The results of the [illegible] are being presented to National Aeronautics and Space Administration, which has requested proposals for a number of manned Mars mission studies (AW May 13, p. 59).

GE concept is an 800,000-lb. nuclear propelled spacecraft, assembled in earth orbit after launch by four Saturn 5s. One Saturn 5 would launch a payload-propulsion module, and the other three would each carry four propellant tanks.

Propulsion unit is a heat transfer nuclear rocket of 150,000-lb. thrust and 820-sec. specific impulse. Mission duration is 15 months assuming launch in April 1971.



After a five day exploration period, excursion module is launched from Martian surface, above left. Two man vehicle is similar to Gemini in configuration. Excursion module would then rendezvous with the command craft, in an orbit with a 200-mi. perigee. On return to earth, Mars vehicle would enter a parking orbit around the planet, above right, and await rendezvous with a ferry vehicle to transfer crew to earth. Spent Mars vehicle would remain in earth orbit.

NASA Outlines Reusable Booster Studies

By Edward H. Kolcum

Dallas — Unconventional reusable booster, designed to reduce launch loads for non-astronaut passengers, was described here by L. T. Spears of National Aeronautics and Space Administration's Marshall Space Flight Center.

The concept is fundamentally an airplane-rocket vehicle which receives its initial acceleration on the ground takes off horizontally, and employs a winged air breathing or air augmentation first stage that is flown back to the earth for re-use.

Spears discussed the vehicle and its potential at the American Institute of Aeronautics and Astronautics Manned Space Flight Meeting here recently (AW Apr. 29, p. 26). His report is largely a compilation of findings based on NASA-sponsored studies conducted by Boeing, Lang Temco-Vought, Lockheed and North American Aviation.

His hypothesis was that future space travelers will be of varying ages and physical conditions. Consequently, the main constraint in design is a 2.3g maximum flight acceleration, with 4g under abort conditions.

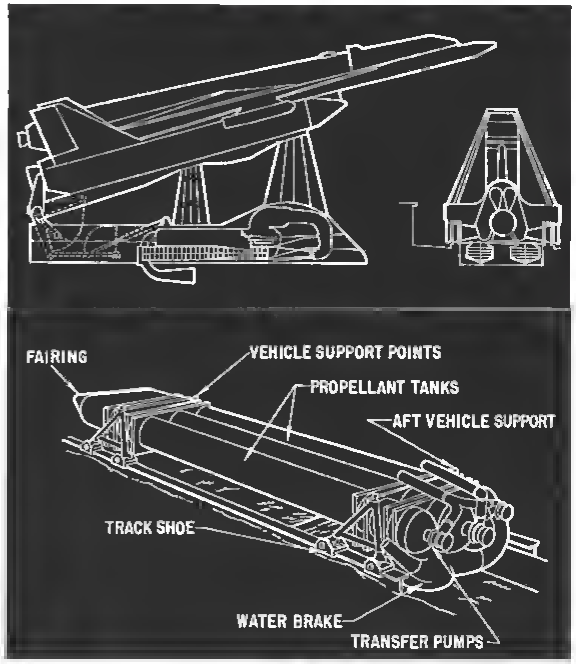
Both horizontal and vertical launch were studied, but with the non-astronaut passenger requirement, horizontal takeoff was selected as preferable. In addition to reducing launch accelerations, it simplifies preparation of vehicle, passengers and payload, according to Spears.

Vehicle liftoff weight is kept at a minimum because the heavy undercarriage and initial boost propulsion remain on the ground. Two basic ground accelerator concepts were studied (see drawings):

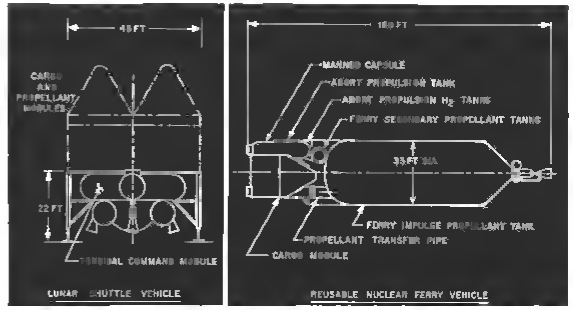
• **Liquid propellant rocket sled.** This is similar to sleds now in use, except that the flight vehicle rocket provides propulsion for the sled. The fuel used for the initial boost is replenished from tanks carried by the sled. Because all boost propulsion operates from the start of the ground run, the complete launch system can be checked prior to liftoff. If there is a malfunction, the sled has water brakes to abort the mission before the vehicle leaves the ground.

• **Linear steam turbine.** Although this system has not been studied in as much depth as the rocket sled, a greater impulse is theoretically attainable from steam than by exhausting through rocket nozzles. This concept employs turbine blades along a track.

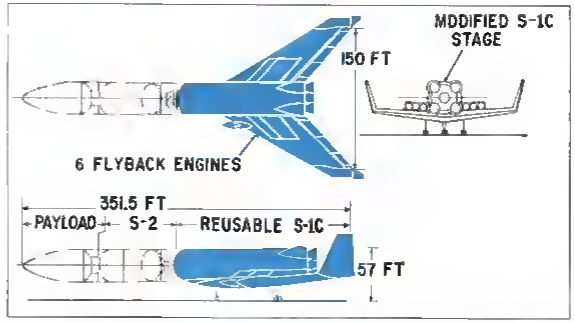
The rocket aircraft reusable booster vehicle is conceived in two time frames: the first is based on Saturn 5/Apollo technology designed to transport 10 passengers plus crew and a limited cargo,



LINE DRAWINGS show two concepts for propelling a ground accelerator which will boost a ferry or shuttle vehicle for orbital operations on a horizontal takeoff. At top is a linear turbine, employing turbine blades along the track, with a winged recoverable booster positioned in the launch configuration. Below that is a sled propelled by liquid rockets. In the sled concept, the propellant tanks would replenish tanks on the rocket vehicle which would be ignited to give the sled its acceleration.



CONCEPTUAL LINE DRAWING shows a reusable nuclear ferry vehicle and lunar shuttle vehicle. With the dimensions listed, the ferry weighs 550,000 lb and can carry 22 passengers and 55,000 lb useful cargo and propellant for the shuttle, carried aft of the ferry unpulse propellant tank. Concept of the lunar shuttle vehicle is based on a system of RL-10 hydrogen engines.



FEATURES OF A SATURN 5 booster modified as a recoverable stage are shown in this drawing Flyback engines could be turbojet or turbofan engines. Span of wings is comparable to that of B-52 and C-133A aircraft

and the second is based on a Saturn 5 with a nuclear escape stage and a reusable 22-passenger nuclear ferry Spears said that although Marshall has concentrated on the rocket end of the spectrum while others have studied advanced air-breathing boosters, there is potential in a mixture of these two propulsion systems A combination of rocket propulsion and air augmentation, he said, could reduce launch noise, improve impulse and provide for longer flight within the atmosphere

The vehicle is thought to be a requirement for operations in earth orbit, and for a lunar exploration base. In a typical earth orbit mission Spears said, the vehicle would be accelerated on the ground to a velocity of about 500 fps in 5 000 ft or less

Liftoff would be followed by a fairly steep climb, followed by a nose-over to a flight path angle of 20 deg at first stage burnout, when the winged booster would separate from the rest of the vehicle The booster would decelerate aerodynamically from the estimated 6,000 fps cutoff speeds turn around and fly back to the launch site using subsonic turbojet or turbofan engines

One concept (see drawing) employs the Saturn S 1C booster modified for winged recovery This system would use existing F 1 engine technology to provide an orbital cargo carrier in the early 1970s The 150 ft span of the wings compares with the span of the B 52 and C-133A aircraft

Lunar transportation system to support a sizable lunar base of about 50 men could be used to supply initial base facilities and men life support equipment base maintenance and improvement and return vehicles Although some of the payloads call for only one way trips, Spears feels, it may be desirable to develop a single system which can make both one-way and two way trips

Evolution of the system may start with development of a nuclear escape stage boosted by Saturn 5 Stage based on the Rift/Nerva program would increase the Saturn 5 lunar capability from 90,000 lb to 135,000 lb This initial system would be expendable, but could grow into a reusable nuclear ferry

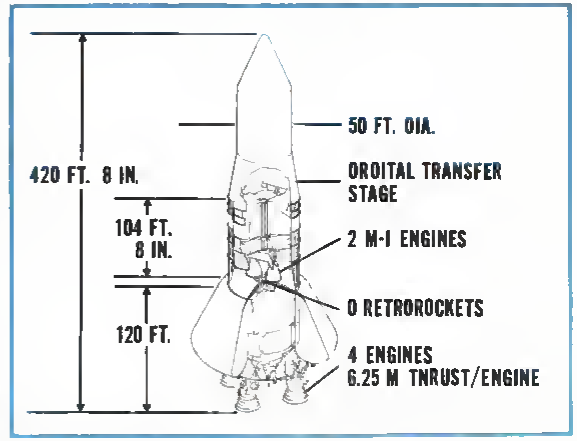
In combination with the earth to-orbit passenger ferry, the nuclear ferry would be loaded with passengers and cargo in orbit taken to a lunar orbit for transfer to a chemical ferry operating between the lunar surface and lunar orbit and the nuclear ferry would return to earth for re-use

Spears said the most critical item in this concept is development of a nuclear propulsion system that can meet the demands of the mission Design criteria, compared to Rift/Nerva, call for three times the thrust three times the power level four to five times the burning lifetime, seven to eight times the number of starts and twice the efficiency in thrust-to-weight ratio

Objectives in the reusable booster studies, Spears said, are comparative analyses of major candidates in sufficient depth so that a choice can be made systems analyses of candidate concepts and supporting research in pacing technologies If these objectives are met, a valid choice can be made of rocket, air breathing or a combination of the two as the propulsion mode for a recoverable boost system

These are the studies aimed at finding answers to critical questions about a nuclear ferry vehicle

- **Parametric studies** to determine requirements, development problems, feasibility and availability for a variety of space missions
- **Design studies** of the nuclear ferry with expendable and reusable boosters of the Saturn 5 and Nova vehicle classes These studies include analyses of radiation environment, maintenance and degree of reliability, micrometeorite protection for long exposure time, cargo packaging crew compartment and abort requirements
- **Operational analysis** to determine how the system might integrate into the total space transportation requirements
- **Orbital operations studies** to determine requirements for servicing and launching nuclear-propelled orbital launch vehicles



GENERAL DYNAMICS/ASTRONAUTICS concept for a fully recoverable and reusable booster based on hydrogen-oxygen propellants Booster is a cluster of four engines, each developing 6 25 million lb thrust

NASA Studies Recovery Systems To Be Used With Future Vehicles

Rotors, landing rockets and controllable parachutes are included in spacecraft recovery systems under study for future vehicle programs by National Aeronautics and Space Administration's Manned Spacecraft Center.

Studies of rotor type recovery systems indicate that they will represent a weight increase of 12-15% of the total recovery weight. Volume requirement will be approximately 12 cu ft per 1,000 lb of recovery weight.

NASA has initiated wind tunnel tests to evaluate dynamic behavior during rotor deployment, vehicle retardation, steady-state descent and helicopter glide and landing conditions. Because of the desirability of providing a backup recovery system, a means for jettisoning the blades to permit deployment of an emergency system must be found.

Three configurations being considered for packaging the rigid-rotor landing system are aft-trailing telescoping, and forward stowage with blades rotated aft for deployment.

Landing rocket design is extremely critical, with the impact velocity being sensitive to errors in ignition times, thrust alignment and changes in spacecraft weight. To be practical a variable-thrust rocket with thrust vector control would be required. Auxiliary spacecraft stabilization during retrofire probably would be needed.

Descent Rates

A system consisting of an earth landing system and a solid propellant rocket optimized for weight and volume, would approximate a parachute descent of 70 fps. It appears more logical however, to design for a parachute descent rate below 40 fps., where careful spacecraft design a rocket failure could be tolerated. Rocket braking has been evaluated using a Mercury boilerplate spacecraft (AW Feb. 4, p. 66).

Controllable parachutes also are being studied as a replacement for the standard parachute because of the added capability of avoiding local obstacles and reducing horizontal wind drift.

Two types studied by MSC include the glidesail and the parasail. The glidesail is basically a standard ringsail parachute modified by adding a control flap which can be extended or retracted to vary canopy angle of attack.

It can achieve lift drag ratios (L/D) from zero with the flap closed to approximately 0.7 with the flap fully extended. Turn control is obtained by varying the length of two single lines which close one flap slot, producing a tangential turning moment from the other slot. Maximum turn rates of approximately 5 deg./sec. are possible. Pendulum stability of the glidesail with control flap open is considerably better than the standard ringsail chute.

Glidesail chutes have been tested extensively, and control flap size and shape have been optimized by studies done in Ames Research Center's full scale wind tunnel. Air drops have been conducted with 63-ft. glidesails and weights giving descent rates from 20-40 fps. For the drops, a control system was installed in the test vehicle and predetermined flight patterns flown.

Heavier Vehicles

For recovery of vehicles significantly heavier than 5,000 lb., it is necessary to use either a single chute of greater than 100-ft.-dia. or a cluster of smaller chutes. For most applications, a single large chute would be undesirable because of the manufacturing, handling, packing and long inflation problems usually associated with big chutes. Tests of a cluster of two 63-ft.-dia. glidesail chutes and a single 63-ft.-dia. ringsail of a delta configuration have been made. The two glidesail control flaps were positioned as a unit to modulate L/D and moved to provide a turning moment. Maximum L/D and turn rate for the cluster were approximately the same as for the single canopy.

Parasail, a French design, has no control flaps. The entire canopy acts as a thick airfoil and a large number of vents spill a portion of the entrapped air to aid in achieving an angle of attack. The apex of the canopy is pulled down to achieve a thinner, more efficient airfoil. This canopy can achieve an L/D of approximately 1, and has the capability of modulating L/D between zero and 1 by varying riser lengths to control angle of attack. Turn control is achieved by varying angle of attack across the leading edge of the canopy or by closing the slots on one side of the canopy for jet effect turning.

MSC has obtained several 23-ft. dia. parasails and studied their performance in a series of truck tow tests and free flight drops. Various fixed control positions were employed to verify L/D approaching 1 and turn rates exceeding 20 deg./sec. Various reefing systems and deployment sequences were tested at indicated equivalent airspeeds of 123 kt. The canopy showed a positive inflation tendency for all configurations tested with excellent pendulum stability through the normal range of canopy angles of attack.

VJ-101C SIDE VIEW shows the podded engines with the intake slot closed. Holes in the pod and in the fuselage aft of the cockpit, where two Rolls-Royce RB.145 lift engines are positioned, may be hoisting points. Prototype has fixed gear.

VJ-101C Effort Is Directed to Possible

Manching, Germany—First hovering flight of Europe's newest vertical takeoff and landing strike fighter, the West German EWR-Sud VJ-101C, is the culmination of a design and development program started four years ago when Bölkow, Heinkel and Messerschmitt pooled a design team to form Entwicklungsring-Sud (EWR).

Aimed at possible production of the far more advanced supersonic VJ-101D fighter, the program now centers on two prototype models of the C version, the X-1 for subsonic flights up to Mach 1, and the X-2, for Mach 1.8 speeds (AW May 20, p. 38).

No decision has yet been reached on building the VJ-101D (AW Oct. 8, p. 30). Production version details have not been revealed, but the airplane will be considerably different from the two VJ-101C prototypes.

Engines will be fuselage-mounted and probably will be Rolls-Royce RB.153 bypass turbojets, which are de-rated versions of the Spey. The delta-wing airplane would be capable of Mach 2 plus speeds.

Rolls-Royce RB.145 pure lift engines power the two prototypes, four mounted in swiveling wingtip pods and two mounted in the fuselage behind the pressurized cockpit. Swiveling time from vertical to horizontal is 6 sec.

Only change between the X-1 and X-2 is that the latter version will have RB.145 engines fitted with afterburners that can be used during the vertical lift-off phase.

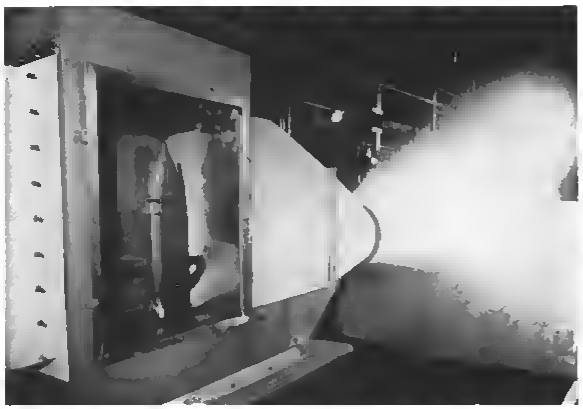
In discussing the concept, Karl Schwarzler, EWR-Sud director, said the VJ-101C project has these advantages:

- **Total installed power** is available for vertical takeoff with no thrust loss arising from thrust deflection.
- **Transition** is simplified through use of the swiveling engines.
- **Control during vertical** takeoff is by thrust modulation, and thus there is no need for control nozzles and complicated ducting systems. There also is no thrust loss due to bleeding engine air for control nozzle effect, according to Schwarzler.
- **All fuel can be stored** in the main fuselage and structure has been kept simple to reduce weight. Weight to thrust ratio of the aircraft reportedly is 0.9.

Schwarzler said studies leading to the VJ-101C concept took into consideration the three European VTOL designs now flying—the Short SC.1 and Dassault Balzac which have separate lift and propulsion engines and the Hawker P.1127, which uses a vectored thrust design.

Since the design team felt that it was more advantageous to use the thrust of the propulsion engines for lifting the aircraft, the VJ-101C project emerged as the most favorable solution. Two engines in each wingtip pod are positioned behind the center of gravity, and the two fuselage engines are installed forward of the cg.

Decision to build the two prototypes followed extensive tests in subsonic and supersonic wind tunnels, main of which were undertaken by Rolls-Royce at its Hucknall, England, flight development



TESTS CONDUCTED by Rolls-Royce in its vertical takeoff wind tunnel (left) used a one-eighth scale pod of the VJ-101C swiveling engine. Proving tests on complete pod mounted on stub wing (right) were made by Rolls-Royce flight development establishment.

ENGINE PODS ON THE VJ-101C are shown rotated to 45-deg. angle. Wire mesh grids cover the intake slots which run around the entire pod and provide additional air during the VTOL phase. Slots are closed for conventional flight.

Mach 2 Version

WEST GERMAN EWR-SUD VJ-101C hovers with wingtip pods in vertical position. Engines are numbered for flight test photography. Aircraft is the X-1 version which will be used to investigate subsonic flight areas. Extra lift engine nozzles project from bottom of fuselage.

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test facility, and by Man-Turbomotoren GmbH.

The six engines form a triangulated group, giving a total lift thrust of 16,500 lb. Stabilization is achieved by varying the thrust of the pairs of the wingtip engines. For normal flight, the two fuselage-mounted engines are shut down and the exhaust nozzles retract into the fuselage to reduce drag.

The RB.145 engine is a derivation of the RB.108, designed in collaboration with Man-Turbomotoren. Afterburner version increases sea level static rating from 2,750 lb. to 3,650 lb. thrust.

Because the VJ-101C is the first VTOL aircraft to use only engine thrust for control, Schwarzler said, a complex series of tests resulted in construction of the Wippe see-saw rig and a free-flying hovering rig.

The Wippe is a horizontal beam supported at one end. It can move up and down at the other end. An RB.108 lift engine is placed at a distance from the oscillation axis. In front of this are the pilot's seat and instrument panel. Arrangement of the lift engine and the pilot's seat is similar to that of the VJ.101C, and the axis of oscillation corresponds to its pitch axis.

To hold the Wippe in horizontal attitude, or any desired angle of incidence, by thrust of the engine, the pilot uses a throttle lever to find the approximate position of equilibrium. In addition, the control column enables him to vary the thrust by ±10%.

Schwarzler said that by matching the static moment and moment of inertia of the Wippe, complete simulation of the VJ.101C control system can be achieved in the pitch axis.

Roll Simulation

When the pilot's seat is removed from the front end of the Wippe and fitted sideways parallel to the axis of oscillation, roll axis can be simulated. Flight disturbances also can be simulated by jettisoning suspended weights.

For the next stage, EWR-Sud built a free-flying hovering rig, fitted with three RB.108s installed in an uncowled fuselage made of steel tubing. It included side booms at the same distances from the cg as in the VJ.101C. Landing gear is the same as on the aircraft with respect to track, wheelbase and cg.

Tethered tests on a pedestal were made initially by installing a Cardan joint at the rig cg.

Engine efflux was deflected through underground ducts.

During the pedestal test phase, a dummy wing was fitted so that when the rig was swung sideways from the underground ducts, the ground effects could exert influence on the unit. The rig includes an autopilot.

When the rig was 3 ft. off the ground, there were no noticeable ground effects. Since Bright's first flight, more than 70 flights of the aircraft have been made, some in adverse weather conditions.

With parameters determined by the wind-tunnel studies and successful testing of the two rigs, construction started on VJ.101C prototypes. Both are built of light alloy, aluminum with titanium and steel used in the hot sections. Schwarzler pointed out that structure is clean and simple since there are no engine mountings to clutter the fuselage center section.

Wing extends through the fuselage and is attached by six bolts. Left engine compartment adjoins the pressure cabin and its ejector seat. Behind the compartment are two large fuel tanks. Nose section has been designed to accommodate a radar unit and test telemetry equipment.

Initial Test

Initial testing of the X.1 prototype was conducted on a pedestal before it made its first free hovering flights Apr. 10. Schwarzler credits the pedestal system with ironing out bugs. He noted that no changes have been necessary in either the aircraft or autostabilizing system.

On the pedestal, the X-1 was tethered at the center of gravity and had freedom of movement on all three axes. Because of the fuel tank position, it was not possible to fit a Cardan joint at the cg., so external joints were installed on both sides of the fuselage to support it while allowing a roll about the center of gravity. The pedestal is a hydraulic cylinder. The aircraft was rolled over the pedestal and attached by two bolts—a 10-mm. operation at the maximum.

Because the freely hovering aircraft was in neutral equilibrium, small unbalanced forces cause it to move at an unlimited attitude. Pilots could achieve restoration by a movement of the control stick alone, which produced angular accelerations.

One axis can be mastered with acceleration control with some care on the part of the pilot, but control of three axes by this means proved very trying, Schwarzler said. He recommended an autopilot for all-weather operations and in any case for pitch and roll. In general a damping system suffices for the yaw axis. EWR Sud is working with Minneapolis Honeywell and Bodenseewerk Perkin Elmer and Co. in autopilot development.

Development of the swiveling engines was pressed when it was found that a cost in weight for jet deflection was at least as high as for engine swiveling. Also the thrust loss in thrust deflection is avoided in the latter system.

Swiveling engines also permitted the use of afterburning powerplants for the liftoff phase and supersonic flight. Two solutions to the swivel problem were explored, one based on a large-diameter ball bearing in the side wall of the pod about which the pod rotated, and another incorporating a hollow shaft passing through the pod between the two engines. This latter version was selected for the two experimental aircraft.

Control Rods

Control rods for engine operation passed through the hollow shaft, along with the necessary piping for fuel and hydraulic fluid. Aim was to reduce as much as possible the number of services in the shaft. For this reason, engines are started hydraulically to utilize the same lines already existing for hydraulic pumps. The pod is swiveled by a hydraulic jack which has two hydraulic pistons arranged in tandem.

Complex design area was construction of the pod air intakes, because of the supersonic speeds which will be attained by the X.2 version of the VJ-101C. Solution was a slot which runs around the entire pod and which is produced by moving the entire intake section forward. Schwarzler said this gave a sufficiently good pressure distribution at the engine inlet under all conditions of oblique approach flow during transition.

Use of thrust modulation for control in VTOL flight arose from the triangular arrangement of the engines in a planview. After the engines have been started, throttle linkages are switched to one common throttle lever with which total thrust can be controlled vertically.

Thrust control for pitch and roll is connected to the aerodynamic flight control system so that movements of the control column produce corresponding adjustments in the throttle linkage.

Aerodynamic controls are connected during hovering, but are ineffective. On swiveling pods to the horizontal position for transition, thrust control is gradually switched off in the same degree as the aerodynamic controls become effective with forward speed.

Several foreign firms have participated in the VJ-101C program. In addition to Rolls-Royce, Britain is represented by Dowty Rotol hydraulic flying controls, Dunlop wheels, tires and brakes, Martin Baker ejection seats, Joseph Lucas fuel pumps, Normalair air conditioning and oxygen system, and Plessey program control for swiveling engines.

U.S. firms involved are Vickers, Inc., for hydraulic pumps and starters, and Electro Mechanical Research, Inc., for the telemetry system. French firms are Sumo control components, Saft Voltabloc batteries, Sfena directional gyro, and Superflexit for linkage.

Survivability of Wire on Moon Tested

By Philip J. Klass

Washington—Only two types of insulated wire appear suitable for use in the lunar environment and even these require special treatment to remove condensable contaminants, Hughes Aircraft Co.'s H. S. Adams reported here during the recent Electronic Components Conference.

This conclusion is based on extensive tests conducted by Hughes prior to selecting insulated wire to be used in the Surveyor lunar spacecraft which the company is building for National Aeronautics and Space Administration.

Lunar environment is a rugged one for avionics components. They will be subjected to the estimated −300F temperature of the lunar night with rapid transition to a lunar day temperature estimated at 280F.

During the high-temperature environment of the lunar day, there is no air to provide convection cooling. The vacuum of the moon is estimated at approximately 10^{-12} mm Hg (torr). Under these high-temperature vacuum conditions, there is danger of outgassing from the wire insulation, with the possibility that the material may condense on the optics of one of several TV cameras used on Surveyor. Or if the material is partially conducting, it may condense on a cool surface and cause a partial short circuit.

With no air for cooling at the 280F temperature, the normal current-carrying capacity of wire must be derated. Under the extreme cold condition there is danger of breakage in cables which must undergo periodic flexing, and the load on motors driving antennas connected by flexing cable is greatly increased.

With these problems in mind, Hughes launched its investigation of different types of insulated wire. Initial tests in which a variety of insulated wires were subjected to liquid nitrogen temperature (−315F) showed that many types of insulation were unsuited because of brittleness at this temperature. These included polyethylene, neoprene, vinyl and silicone.

For detailed tests, the field was narrowed to wire insulations made of TFE Teflon, an FEP Teflon coated with a modified polyimide lacquer known as Surok, and irradiated polyolefin. The last is less vulnerable to radiation damage than the first two, but Hughes plans to shield its cables with aluminum foil. For that reason, radiation resistance was not considered a major requirement for Surveyor.

Based on Hughes tests, Adams reported the following conclusions as to the choice of insulated wire for lunar use:

• **Conductors.** Alloy 63 and copper wire both are suitable for lunar use. Alloy 63 had about 10% less conductivity than copper, but it demonstrated considerably greater longevity under flexing tests at room temperature and one atmosphere. This should permit use of a minimum wire size of 24 AWG with Alloy 63 instead of larger 22 AWG for copper wire, providing about a 30% saving in weight, Adams said.

• **Insulation.** Surok offers the best compromise of properties of the three types of insulation tested in terms of outgassing, high temperature stability and weight, although TFE Teflon exhibited slightly less outgassing. Irradiated polyolefin is lighter in weight but exhibited the highest outgassing of the three materials.

• **Current capacity.** TFE Teflon wire experienced the least temperature rise in a simulated lunar day environment, but the differences in wire temperature gain were small.

Hughes investigated the possibility of cleansing the three types of insulated wire by first exposing them to a vacuum of 10^{-5} torr at a temperature of 260F for a week. Then they were operated in the 10^{-5} torr simulated lunar environment to see if the subsequent outgassing could be eliminated or reduced. Hughes found that such pre-treatment greatly reduced the outgassing from TFE Teflon and Surok, but had little effect on the irradiated polyolefin insulation. However, Adams conceded that a longer period of exposure during the pre-treatment process might draw out contaminants from the polyolefin.

During the insulation outgassing tests conducted at temperatures of approximately 260F and a pressure of about 10^{-7} torr, after a week's exposure the irradiated polyolefin had lost 0.23% of its weight, the Surok had lost 0.5%, but there was no detectable loss for the TFE Teflon. Adams reported. In another test in which the current through

Transistor Circuit Failures Traced

Washington—Recent investigation indicates that circuit transients may be responsible for previously unexplained failures in solid tantalum capacitors, widely used in transistorized circuitry, W. G. Bailey, Cornell-Dubilier Electronics reported here during the recent Electronic Components Conference. Circuit designers either are not aware of the presence of such transients or else do not realize that solid tantalum capacitors have limited ability to withstand transient pulses whose voltages exceed the surge voltage rating of the device, Bailey said.

The transients cause a high d.c. leakage or short circuit, usually resulting in a catastrophic type of equipment failure, Bailey said that circuits should be analyzed to determine the wave shape, peak voltage and repetition rate of any transients appearing across the capacitor. If the transient pulse width is less than 10 milliseconds and the repetition rate is less than a few pulses per second, no thermal problem can be expected.

But if the transient is charging the capacitor to more than its surge voltage, a capacitor with a corresponding higher voltage should be used, Bailey said. For maximum reliability, the peak charging voltage should not exceed the rated voltage or derated voltage if operated at high temperatures.

An investigation by Boeing to determine the failure mechanisms and environmental limits for different types of electrical connections shows that soldered connections lose mechanical strength rapidly at temperatures about 200F, W. K. Antle reported. The performance of crimp connections depends upon the strength of the wire itself while welded connections using nickel wire resist high temperatures better than others tested, he said.

For equipment designed to have a mean life of five years, Boeing's tests indicate the following upper temperature limits for different types of connections:

• Welded joints: 540F
• Crimp connections: 320F
• Soldered contacts: 140F.

The results of company tests to determine resistance to periodic mechanical shock indicate that wire wrap joints can withstand the highest shock levels, followed in order by welded joints, soldered contacts, and crimped connections.

the wire in the 10^{-7} vacuum was increased until "substantial outgassing" occurred, the irradiated polyolefin experienced outgassing at a temperature of 380F, the Surok at 500F and the TFE Teflon at 575F.

In tests conducted to determine the current capacity of different insulated wires under simulated lunar vacuum conditions, using 20 AWG size wire samples, Hughes found that for a 25F temperature rise above ambient the irradiated polyolefin must be derated by 50%, Surok by 44% and TFE Teflon by 40%. For a 50F rise above ambient, the respective derating factors were 44%, 41% and 36%, Adams said.

An antenna array in Surveyor uses no slip rings to permit rotation, requiring instead the flexing of connecting cable. Since the stiffness of the cable at lunar night temperatures is a major factor in determining the size of motor needed to drive the antenna, Hughes ran tests to measure the stiffness of insulated wire cables at —315F. Using a 10 inch cable consisting of 61 strands of 22 AWG wire, the cable was flexed into a U-shaped configuration at liquid nitrogen temperature. The TFE Teflon and Surok insulation did not crack when bent through 180 degrees but the irradiated polyolefin fractured with as little as a 15 degree bend. The force required to flex the cable increased by a factor of 4:1 from the value of room temperature.

In tests conducted at room temperature to determine the number of flex cycles a 24 AWG copper conductor could withstand before failure, Hughes found that the Alloy 63 operated for 830 cycles before breaking while a copper conductor failed after 594 cycles. In all cases the conductor failed before any insulation damage was evident but the test was conducted at room temperature.

The Hughes tests point up the fact that for the lunar environment the selection of even such commonplace avionic materials as insulated wire cannot be taken for granted.

Also reported at the Electronic Components Conference:

• **Vapor-deposited chromium film resistors,** when effectively protected against humidity, can be expected to experience an average drift in resistance value of 1% or less in 10,000 hours when used in a typical computer environment, A. O. Fowler of International Business Machines Corporation reported, based on an extensive IBM test program.

• **Solid electrolytic silicon capacitor,** a new type which exhibits capacitance of 0.01 mfd per sq cm at working voltage of 15 v., can be used at temperatures up to 400C and should have a lifetime of more than 1,500 hours at the 400C temperature, according to a report by Yoshiaki Ishikawa and Shinichi Inowaki of Nippon Electric Company, Ltd., Kawasaki, Japan.

• **Flat-conductor connector,** for terminating thin ribbon conductors without scraping off the plastic encapsulation, has been developed by Burndy Corporation, Norwalk, Conn., under Army contract. The connector, which contains wedge shaped teeth that bite into the encapsulation without damaging the flat ribbon conductors, was described in a report by Henry Dupre, of Burndy, and Elmer F. Goodwin and Gerard J. Reilly of Army's electronics research and development agency.

• **RFI shielded cable connector,** developed for missile firing circuits operating in a high intensity electromagnetic radiation environment, was described by W. J. Mashek of Amphenol Borg Electronics Corp., which developed the new connector under Navy sponsorship.

• **Radiation tests on solid tantalum capacitors** at levels of 100 roentgens per hr., corresponding to the highest levels reported for the natural Van Allen belt, produced no measurable effects on capacitance, dissipation factor or leakage current after 144 hr. exposure, according to a report by I. R. Doshay of Space General Corporation, K. N. Lambert and R. J. Millard, both of Sprague Electric Co. A cumulative dosage of about 100,000 roentgens, at a rate of 450,000 roentgens per hr., caused deviations of about 1% in capacitance and dissipation factor. Leakage current after a cumulative dosage of about 10,000 roentgens varied considerably depending upon the rate of exposure.

• **Anodized tungsten thin-film resistors,** with sheet resistivities as high as 2,000 ohms per square and temperature coefficients better than 200 ppm/deg C, and sheet resistivities as high as 360 ohms/square with zero temperature coefficient have been obtained by General Telephone & Electronics Laboratories, Bayside, N. Y. Resistance was stable within 1% per 1,000 hours while dissipating 2 watts/sq. in. at 25C for 2,000 ohm/square films and 8 watts/sq. in. for 250 ohm films. However, thin film tungsten oxide capacitors often changed capacitance as much as 100% over a period of several weeks. Report on the development was jointly prepared by E. R. Bateman, J. W. Culp, P. F. Hudock, and F. Leder of GT&E Laboratories and H. J. Degenhart of Army Signal Research and Development Laboratory.

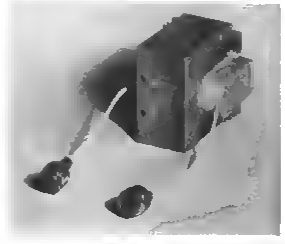
• **Hybrid thin-film semiconductor microcircuit** in which thin-films of tantalum and tantalum pentoxide are deposited on top of a silicon microcircuit to provide a wider range of available resistance and capacitance values, was reported by T. Sikina, M. Casey, J. Saunders and F. Murray of Philco's Microelectronics Department.

NEW AVIONIC PRODUCTS

• **Multi-function logic element,** single crystal device utilizing both bi-polar and uni-polar transistor action, can be used to provide variety of computer logic functions, including AND, OR, NOR, NAND, Exclusive OR, bi-stable flip-flop, mono-stable flip-flop, multivibrator and inverter, according to manufacturer. Presently available configuration has four high-impedance inputs and can switch at rates of 1 mc or higher with large fan-outs. Device called Nentron is priced at $85 in limited quantities. Manufacturer, Crystalonics, Inc., 147 Sherman St., Cambridge 40, Mass.

• **Stretchable** coaxial cable which can experience elongation of up to 400% without damage to multiple conductors is available with jacket of synthetic fiber plastic or silicone rubber. During elongation the capacitance of cable increases linearly at 3½ mmfd per foot of elongation. Cable is suitable for underwater use. Manufacturer, NRA, Inc., 35-01 Queens Blvd., Long Island City 1, N.Y.

• **Electronically tunable microwave filter,** available in five standard types covering frequency range of 500 mc to 12 gc (knee), comes in two or four-cavity models containing corresponding number of single-crystal yttrium-iron-garnet spheres which permit extremely rapid tuning. Four-cavity filter for 500-1,000 mc use has sweep bandwidth of 10 mc. at 3 db points with maximum insertion loss of 12 db. Device weighs less than 2 lb. and meets environmental requirements of MIL-E-5400 according to manufacturer. Loral Electronics Corp., General Products Div., 825 Bronx River Ave., New York 72, N.Y.

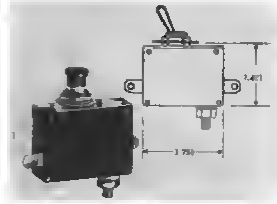


• **Non-destructive d.c. voltage breakdown tester,** Model 1901A, does not damage test specimen nor endanger operator. Damage is prevented by automatically shorting out test leads before breakdown occurs, limiting current avalanche through specimen to three microseconds duration. Meter on panel shows amount of voltage applied to specimen with memory circuit holding reading until next test is performed. Selector switches permit choice of 1 kv or 4 kv test voltage and amount of ohmic current flow can be selected. Manufacturer, Microdot, Inc., 220 Pasadena Ave., South Pasadena, Calif.

• **Laser output sensor** measures short-duration light emission from near ultraviolet to near infrared (0.35 to 1.13 microns) giving readings of average power on a built-in meter. Waveshape, rise and fall time, duration and energy measurements can be displayed on a fast oscilloscope.

Device is called Lite Mike and has swivel-mounted detector head which is detachable for remote readings. Manufacturer, Edgerton, Germeshausen & Grier, Inc., 170 Brookline Ave., Boston 15, Mass.

• **High-speed circuit breaker,** with nanosecond response time to transient and long-term over-voltage and over-current, uses built-in diode as sensor. One model provides combined over-current and over-voltage protection while another provides voltage limiting and automatic system recovery for short transients. Both are available either with push-pull or toggle actuators in wide choice of terminal configurations and ratings. Manufacturer, Metals & Controls, Inc., division of Texas Instruments, Inc., 34 Forest St., Attleboro, Mass.



• **Pellet film resistors,** available with values of 10 ohms to 2½ megohms, rated ¼ watt at 125C with suitable packaging, measure 0.063 in. thick by 0.10 in. in diameter. Temperature coefficient is quoted at less than 300 ppm/deg C be-

Low-Noise Parametric Amplifier Advance

New indium-antimonide varactor diode which enables a parametric amplifier cooled only to liquid nitrogen temperature (77K) to provide low-noise performance comparable to that of a more complex maser cooled to liquid helium temperature (4.3K), has been developed by AIL Division of Cutler-Hammer (formerly Airborne Instruments Laboratory).

The development is another example of parametric amplifier performance advances which pose a threat to more costly and complex maser amplifiers (AW Jan. 28, p. 73).

The AIL indium-antimonide varactors exhibit typical cutoff frequencies of 150 gc (knee) and some units run as high as 400 gc when cooled to 77K. Company scientists predict that ultimately this value may rise to 1,000 gc, enabling the devices to operate far into the millimeter region.

A 5 gc degenerate-type parametric amplifier using the new diodes, cooled to 77K, exhibited an effective noise temperature of 11K at 20 db gain, and 7K at 30 db. This exceeds the performance reported by Lincoln Laboratory using gallium-arsenide diodes cooled to 4.3K. The AIL diodes are diffused abrupt-junction types with zero-bias capacitance of 0.1 to 1.0 picofarad.

Varactors were developed by AIL's research department, headed by Dr. Bernard Salzberg, in association with Carrol M. Allen and Paul R. Liegey.

tween temperatures of –65C and 150C. Pellet resistors also are available in thicknesses of 0.030 in. with values to ½ megohm. New line of pellet resistors

is priced at one third of earlier models. Manufacturer: P. R. Mallory & Co., Microcomponents Div., Indianapolis 6, Ind.

• **Wire-wrap connection tester** is designed to apply pulling force to a wire-wrap connection to determine point at which connection begins to fail. Gage

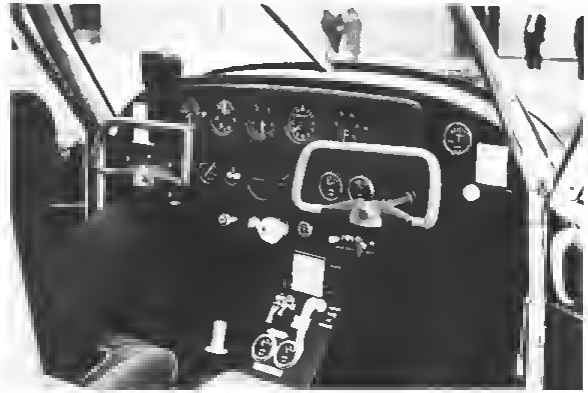
dial retains maximum force reading until reset for next test. Device is available in 14 models covering range of forces from 500 grams to 30 lb. Manufacturer: Hunter Spring, Division of Ametek, Inc., Hatfield, Pa.

• **Conductivity measurement probe**, thermo-electrically cooled, can be used to measure epitaxial layers as thin as two microns and high resistivity layers on low-resistivity substrates. Probe contains two current leads and a potential lead with a second potential lead operating at room temperature. Use of galvanometer is recommended for potential measurements. Manufacturer: Westinghouse Semiconductor Div., Special Products Dept., Youngwood, Pa.

• **Subminiature trimmer potentiometer**, Series 388, with resistances of 100 ohms to ½ megohm, comes in a TO-5 size case (⅜ in. dia.). Potentiometer's cermet element provides high stability under extreme environmental conditions and provides infinite resolution. Rating is ½ watt at 125C with maximum of 200 v.d.c. across resistance element. Manufacturer: CTS Corp., Berne, Ind.

• **Far-ultraviolet multiplier phototube**, Model 542G-08, has peak sensitivity in the 1,250-1,450 Angstrom region and is insensitive to visible radiation beyond 2,100 Angstroms. Lithium fluoride window and semi-transparent photocathode gives device a quantum efficiency of 10% at 1,215 Angstroms. Device employs 18 stages of amplification and is encapsulated in fiber glass shell 2 in. dia. x 5½ in. long. Manufacturer: Electro-Mechanical Research, Inc., Princeton Div., Princeton, N.J.

Sud Aviation Begins GY-80 Horizon Production



Gardan GY 80 Horizon privately developed four place, all-metal French sport business plane now is being produced by Sud Aviation. It is powered by a 150 hp Lycoming O-320-A engine with fixed pitch propeller. Model with a 160 hp Lycoming O-320-B engine and Hartzell constant-speed variable-pitch propeller also is offered.

Cockpit (left) is entered through two forward-folding doors. Panel arrangement is conventional for light single-engine aircraft, except for central console. Landing gear and interconnected flaps are raised and lowered with hand crank between seats.

Low level flyby shows how Horizon gear retracts rearward onto partially. Tail design features sweptback fin, all-flying stabilizer and tail skid. Maximum speed is 153 mph., cruising speed is 146 mph. and stalling speed is 52 mph. Nose wheel is steerable. Aircraft pictured has Swiss markings.

Skymaster Production Speeded by Cessna

Production of the Cessna Model 336 Skymaster is being increased at the company's Wichita, Kan., factory to more than one per day. Aircraft a 4-6 place, tandem-engine twin (AW Mar. 18, p. 88), recently began a worldwide sales tour.

PRIVATE LINES

First Cessna Model 172s to be assembled in France by Reims Aviation have been completed and current plans call for an increase in the assembly rate to approximately 10 aircraft per month. Reims is 49% owned by Cessna. Program calls for Reims to gradually phase from assembly of Cessna-furnished components to complete fabrication of the aircraft.

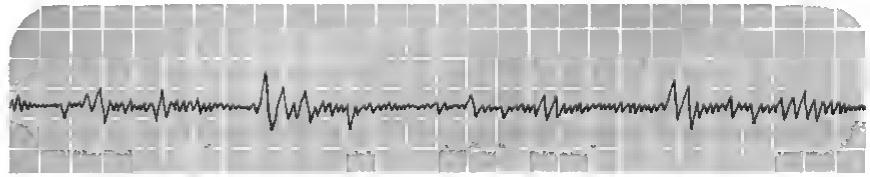
Federal Aviation Agency now is requiring pilots to obtain advance authorization before operating civil aircraft with one door removed for sky diving, photography or similar operations. FAA also has published a list of civil aircraft approved for operation with a door removed. List covers most Cessna, Piper, Champion, Stinson and Taylorcraft single engine aircraft, some Beech twin engine aircraft and several Howard and Noorduyn series. Pilots should make written application to the nearest FAA General Aviation District Office.

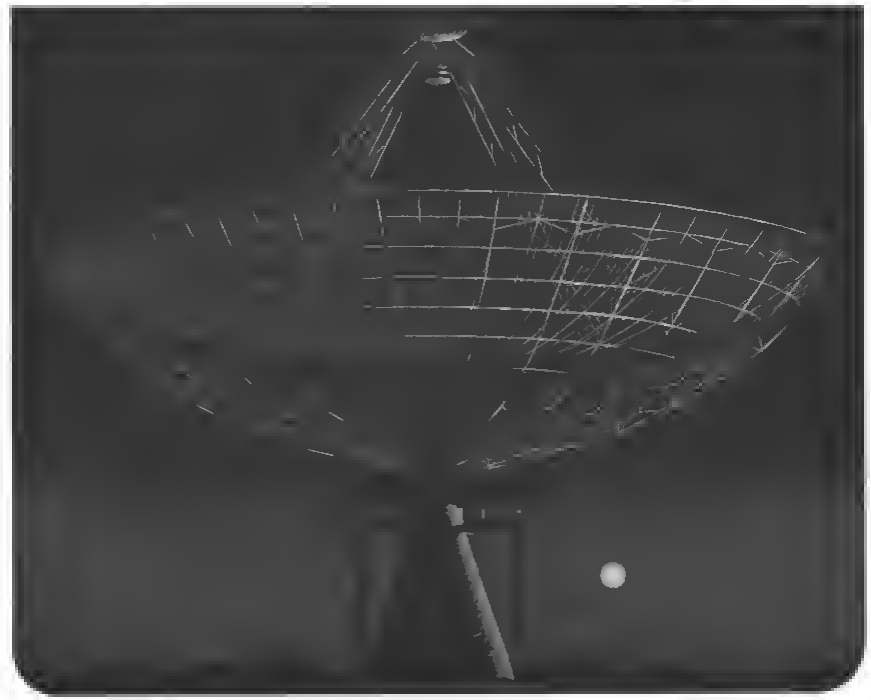
Champion Aircraft Corp. has received a type certificate for the Lancer 402 two-place light twin. Aircraft is powered by two 100-hp. O-200A Continental engines and has a fuel capacity of 60 gal. With deluxe interior, the aircraft will sell for less than $13,000.

Cessna is marketing a new line of navigation and communications equipment under its own brand name. Known as the Cessna Crafted 500 series, the line contains a transceiver with 50-kc. spacing between 118.00 and 135.95 mc., a navigation communications system with a 360-channel transmitter and a 380-channel receiver and 50-kc. spacing, and an omni receiver including 20 glide slope channels and a three-band automatic direction finder.

Landing gear for the Hamburger Flugzeugbau HFB-320 Hansa twin-turbojet executive aircraft will be developed and manufactured by Hispano Suiza. Hydraulically controlled main gear will rotate and retract forward into the fuselage of the aircraft. Hispano Suiza makes gears for the Caravelle, Mirage 3 V and Breguet 1050.

Edo Corp., of College Point, N.Y., earned $118,000 on sales of $3.6 million for the first quarter of 1963. First quarter 1962 earnings totaled $48,000 on sales of $3.7 million.





Congressional Questions Remain Unanswered on GE Support Award

By Alfred P. Alibrando

Washington — Disagreement within National Aeronautics and Space Administration over selection of the General Electric Co. to provide test support and housekeeping services at the Mississippi Test Facility apparently has been resolved. NASA last week still had not answered congressional inquiries on how the selection was made.

House space committee members recently questioned NASA officials on the agency's Fiscal 1964 budget request on both the original GE Apollo integration and checkout contract and its extension to cover support work at the test facility.

The inquiry did not satisfy Rep. William F. Ryan (D-N.Y.) and he asked NASA to submit a written report to the committee, including answers to questions such as these:

- Why was GE selected on a sole source basis to perform housekeeping services at the Mississippi Test Facility that could be performed by any of a number of firms?
- Did Marshall Space Flight Center concur in the NASA headquarters decision to select GE?
- Did D. Brainerd Holmes, director of NASA's Office of Manned Flight, agree to the selection or was he directed by NASA Administrator James E. Webb to negotiate with GE?

GE Selection

GE was selected by NASA in February, 1962, to perform integration, checkout and reliability assurance work in the Apollo program.

At the time of the original selection, some members of the House space committee were critical of NASA because the agency did not select a contractor through open competition (AW Apr. 2, 1962, p. 38).

House space committee members continued their critical questioning (AW Apr. 22, p. 28) on the original contract this year. When Holmes and Dr. Robert C. Seamans, Jr., NASA associate administrator, appeared before the tracking and data acquisition subcommittee on Apr. 9, they were asked if the agency planned to extend the contract. They replied that no additional work would be placed under the contract.

Then, on Apr. 16, NASA announced it would negotiate with GE for extension of the original Apollo contract to include the support role at the Mississippi Test Facility. This action brought an angry reaction from Rep. Ryan, when Ernest W. Brackett, NASA procurement director, appeared before the tracking subcommittee on May 2.

"There was no indication, no statement to this committee on Apr. 9 that there was any intention of an announcement on Apr. 16 of extending the contract to include service functions," Rep. Ryan said.

When Rep. Ryan asked who made the decision to extend the GE contract, Brackett replied:

"This decision was made by our top management, I believe." He said he did not know the details and was not consulted.

Michoud Work

Subcommittee members pointed out that selection of a firm to do support and service work at NASA's Michoud plant, near New Orleans, was made through a competitive procedure. Brackett said the firm of Mason & Rust was selected for the Michoud job from among some 20 which submitted bids. Saturn 5 vehicles assembled at Michoud will be static tested at the nearby Mississippi Test Facility.

A prime point in Rep. Ryan's questions to Brackett concerned the kind of work to be done by GE under the contract extension.

"I think this raises a very serious question," Rep. Ryan said. "You take one of the giants of the aerospace industry that has a very peculiar relationship with NASA to begin with, and award — a contract upon which it will make a profit to provide cafeteria services, guard services, parking lots. It seems to me this is way beyond the purview of GE."

Brackett defended the contract extension on the grounds that it would be much simpler and easier for NASA to deal with one contractor responsible for all activities at the Mississippi Test Facility than with many firms. He also pointed out that GE has performed similar management functions for the Atomic Energy Commission and other government agencies.

Brackett said many of the housekeeping functions, such as operation of cafeterias, fire-fighting equipment and plant protection, would be performed by subcontractors. Later, NASA officials said

these subcontractors would be selected though competitive bidding.

Walter Lingle, an assistant NASA administrator, said Brackett was not consulted on the GE contract extension because John D. Young, director of the Office of Administration, rather than Brackett was the top responsible contracting officer. Young said it was his "impression" that he was called by Holmes and directed to inform Wilbur Davis, Marshall Space Flight Center procurement chief, to begin negotiations with GE.

Several NASA and industry officials, familiar with the agency's internal differences over the GE contract extension, gave AVIATION WEEK & SPACE TECHNOLOGY this information:

- **Opinion within Marshall** Space Flight Center, which has responsibility for managing the Mississippi Test Facility, was divided on how the contractor selection should be made.
- **Brainerd Holmes opposed** selection of GE on a sole source basis, and had been fighting such a course dictated by NASA Administrator James E. Webb.
- **Apollo contractors** and subcontractors have been reluctant to provide GE with information necessary for the firm to carry out its integration, checkout and reliability role.
- **James E. Sloan's decision** to resign as NASA's director of integration and checkout and return to the Radio Corp. of America was at least partially due to the decision to extend the GE contract.

Here are NASA's answers to these points, made either directly to AVIATION WEEK & SPACE TECHNOLOGY or in congressional testimony.

Lingle said there was a difference of opinion among Marshall officials on which firm should be selected, but not on the method—Marshall officials were united on a sole source selection.

Holmes said the Marshall procurement plan received by him recommended that NASA negotiate the contract with GE on a sole source basis. Holmes also said he endorsed this procedure.

Contractor Reluctance

The matter of Apollo contractors and subcontractors being reluctant or refusing to provide GE with information also has been brought to the attention of the House manned flight subcommittee. Subcommittee members pointed out to Holmes that a chart they saw on a recent trip to the Downey, Calif., plant of North American Aviation—prime Apollo contractor—showed GE as a subcontractor to North American. This surprised the committee, which took the position that a firm responsible for checkout and integration could not very well carry out that role as a subcontractor.

Holmes said GE was not a subcontractor to North American and that he thought everybody understood that. "If they don't know now, they will very soon," he told the subcommittee.

Rep. Edward J. Gurney (R., Fla.) said it was GE engineers who told him that some Apollo contractors and subcontractors were reluctant to part with information.

Holmes said he would look into that, too, and assured the subcommittee that any reluctance to pass on information would be corrected.

Sloan's Decision

Sloan said the GE contract played no part in his decision to leave NASA. He said the decision was made largely on the basis of personal considerations.

At no time during the year-long controversy has the ability of GE to perform the integration checkout, reliability or support role been an issue. Rather, the controversy has been over the way NASA selected GE for a contract with a total value of about $635 million for the checkout and integration work through the life of the Apollo program and up to $25 million a year through 1968 for the Mississippi Test Facility support job.

Holmes estimated that the GE contract is among the 12 largest in the $20 billion Apollo program.

Three Groups Formed By Hawker Siddeley

London—Extensive streamlining of the Hawker Siddeley Group recently resulted in a merger of three airplane divisions with sharply defined aims in heavy military aircraft, fighter development and civil air transports.

The new divisions are Avro-Whitworth, formed from A. V. Roe and Co., Ltd., and Whitworth Gloster Aircraft, in the heavy airplane field; Hawker-Blackburn, Div.—an amalgamation of Hawker Aircraft and Blackburn Aircraft, for fighters, and the de Havilland Div. for civil air transports.

A new company, Hawker Siddeley Dynamics, is being formed from the guided weapon and aerospace equipment interests in present subsidiaries of Hawker Siddeley Aviation Ltd. Company chairman will be Sir Aubrey Burke, currently chairman of de Havilland, and general manager will be G. C. J. Gudmer, a de Havilland director. Burke also will act for the managing director of Hawker Siddeley, Sir Arnold Hall, when circumstances require.

All the divisions now fall under Hawker Siddeley Aviation, headed by Hall, with J. T. Lidbury as vice chairman and managing director. Sir Roy Dobson remains chairman of the Hawker Siddeley Group.

An unknown factor in the reorganiza

Latest Apollo Configuration Shown

Cryogenic storage subsystem for Apollo life support and power generation is shown in cutaway portion of service module in artist's drawing. Subsystem is being developed by Beech Aircraft Corp.'s Boulder Colo. Div. Drawing also shows latest configuration of the three man spacecraft. Visible on exterior of command module, shown after two LEM crewmen have departed are stabilization strakes. Antenna and control jet systems are shown on service module. LEM (lower foreground) is ascending from moon.

tion, and ignored in the company announcement, is the future of Holland Aircraft, manufacturer of the Holland Gnat. No announcement was made of top echelon executive management of de Havilland with exception of a statement that Lidbury will have general responsibility to the Hawker Siddeley Group for airplanes, but one is expected soon.

Division heads are Air Marshal Sir Harry Broadhurst, Avro-Whitworth, with G. Bayly as general manager, and R. L. Lickley, chief executive of Hawker Blackburn with E. G. Rubython as general manager.

The other new companies are Hawker Siddeley Holdings, Ltd., to hold as subsidiaries a number of smaller companies trading in industrial products headed by Sir Arnold Hall, and Hawker Siddeley International Ltd., to hold all Hawker Siddeley sales companies, with A. S. Kennedy, director of sales, as chairman.

New member of the Hawker Siddeley Group board is Sir Sidney Camm, designer of the Hawker P. 1127 VTOL strike fighter.

Grumman Sales Expected to Rise

New York—Sales this year for Grumman Aircraft Engineering Corp. are expected to increase to more than $400 million—primarily because of increased E-2A Hawkeye and A-6A Intruder Navy aircraft sales and not from any effect of the bi-service TFX variable-geometry wing fighter.

Unlike previously employed cost type contracts for development projects in which sales are recorded as costs are incurred, the incentive fixed price contract for TFX will mean sales will not be recorded until deliveries are made.

Grumman's share of the $6.5-billion TFX contract has not been established officially, Grumman President E. Clinton Towl told the New York Society of Security Analysts, but estimates are that it will be about 20%.

Proceeding on the original schedule calling for first flight early in 1965, Grumman has requested bids for long lead time items, is selecting subcontractors, is refining the design and is tooling for production work. Towl's only reference to the controversy over the TFX that has developed in the McClellan subcommittee hearings was a reference to questions he expected from the group after his talk.

"I must forewarn you that I'll probably not be able to answer too many of them since the program is highly classified . . . and for reasons all of you can surmise only too well."

Towl said that Grumman sales in the light of its $1 billion backlog, should continue to increase beyond 1963. Major item in the backlog total is the Apollo Lunar Excursion Module (LEM) program, being developed under a $387.9 million contract from the National Aeronautics and Space Administration. Funding will be disbursed over a seven-year period, but not necessarily in equal increments.

This cost plus fixed fee contract covers design and manufacture of nine ground test and eleven flight test vehicles and operational support. Grumman also is conducting an engineering analysis for NASA of LEM as a lunar logistics vehicle.

Of Grumman's projected 1963 sales, military aircraft will contribute about 80%, Towl said. Space sales are expected to rise from 10% in 1962 to 13% of the total or approximately $52 million. Besides LEM, Grumman also is contractor for the NASA Orbiting Astronomical Observatory scheduled to be checked out in prototype form by August and launched in late 1964 or early 1965.

Breakdown of the company's 1963 sales in percentages, as given by Towl includes the following:

- **Early warning aircraft**, the E-2A and E-1B (WF-2)—30%
- **Observation, reconnaissance, and attack aircraft**, the OV-1 Mohawk and A-6A Intruder—40%
- **Anti-submarine and utility aircraft** the S-2E Tracker and the HU-16E Albatross—9%.
- **Space**—13%
- **Commercial**—8%

Grumman's commercial projects include the Ag-Cat agricultural biplane, whose sales of 82 aircraft last year exceeded total previous deliveries of the airplane, and the twin turboprop-powered Gulfstream, of which 18 were sold. Grumman's total 1962 aircraft sales were 248 aircraft: 128 military, and Albatross modifications for foreign nations under Air Force contract.

Gulfstream sales reached a total of 109 in May, and customers include, besides private corporations, the U. S. Coast Guard, NASA, and the Federal Aviation Agency.

Towl also forecast increases in profits for 1963, but higher interest charges will offset some of the prospective benefits of cost reduction programs. Because of higher depreciation expected in 1963—$8 million as against $5.2 million—cash flow will rise, but Grumman is planning to augment working capital to handle its growing volume of business with a $10-million long-term borrowing agreement. It will not be through equity financing, however, Towl said.

Proposed Dept. of Defense profit guidelines should not affect Grumman's profits, Towl said, since the current level is relatively modest. Towl believes the accompanying performance rating system should enhance Grumman's position because of the company's past record of meeting reliability standards and targets.

Grumman has a unique record in the aerospace industry of showing a profit in every year of its 33 years of existence and similarly has an unbroken record of paying yearly cash dividends to stockholders.

Despite growth in business, Grumman plans no increase at the moment in its $1.50 annual dividend.

Shifts at MSC Define Management Areas

Houston—Definitive division of management responsibilities separating operational from development activities, has been announced by Dr. Robert Gilruth, director of the Manned Spacecraft Center here.

Walter C. Williams, named deputy director for mission requirements and flight operations last November (AW No. 26, p. 25), will develop mission plans and rules, crew training, ground support and mission control complexes and manage all flight operations conducted by MSC. Concurrently, Williams will act as director of flight operations in the space agency's Office of Manned Space Flight, Washington, D. C.

He reports directly to D. Brainerd Holmes in this capacity and has complete mission authority during flight tests of Mercury, Gemini and Apollo spacecraft.

James C. Elms, named deputy director for development and programs earlier this year, will manage all MSC manned space flight projects, including total project planning.

In addition to this duty, Elms will plan, organize and direct center activities providing administrative and technical support for the entire MSC operation.

Reporting directly to Williams under the new arrangements will be—G. M. Preston, MSC manager of Atlantic Missile Range operations and chief, preflight operations div.; Christopher C. Kraft, Jr., chief, flight operations div.; Warren J. North, chief, flight crew operations div.; Dr. Charles A. Berry, chief, center medical operations office; Wesley Messing, MSC manager of White Sands Missile Range operations; G. Barry Graves, assistant director for information and control systems, specifically to implement the Integrated Mission Control Center (IMCC) and the ground operations support systems (GOSS); and Kenneth S. Klemknecht, manager, Project Mercury.

Project Mercury personnel, many of whom will probably be absorbed in the mission requirements and flight operations areas on completion of the planned Mercury flights, report to Williams.

Reporting to Elms under the new organizational structure are—Maxime Faget, assistant director for engineering and development; G. Barry Graves, assistant director for information and control systems (other than IMCC and GOSS); Wesley Hjornevik, assistant director for administration; Robert O. Piland, acting Apollo spacecraft project manager and Charles W. Mathews, acting Gemini project manager.

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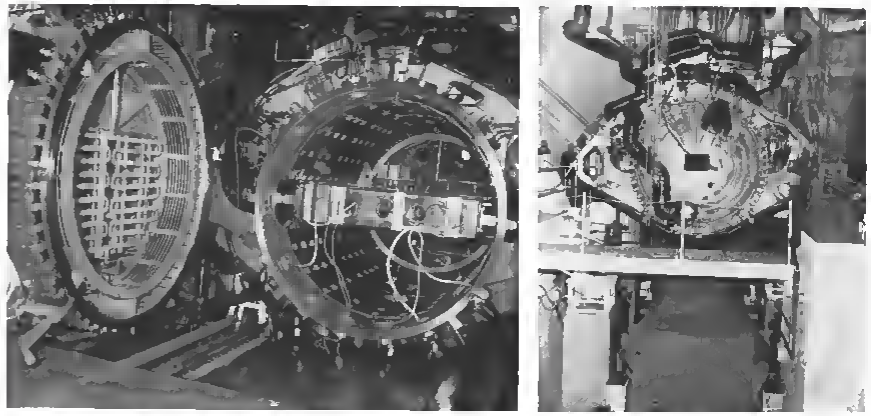


INTERIOR VIEW of advanced recon camera test chamber (left) shows plug-in frame Target simulator is beneath chamber (right)

Simulator Tests Advanced Recon Systems

Dayton, Ohio—First tests utilizing USAF Aeronautical Systems Div.'s recently completed $6-million space simulation facility for testing advanced reconnaissance systems have been completed successfully at Wright-Patterson AFB here.

Facility, nicknamed "Haley's Comet" after Project Engineer James Haley who proposed it five years ago, is designed to conduct dynamic analysis of infrared, photographic and television reconnaissance systems for air and space vehicles in extreme environments prior to test flights.

In the past, advanced reconnaissance systems had to be tested in flight programs nearly as complex as the mission itself. The dynamic analyzer is expected to reduce testing costs by 80% and afford a considerable time saving.

One of the primary considerations in the design of the facility was reduction of "down time" between tests of different items of equipment. Accordingly, the environmental chamber was designed to accept quick-change plug-in frames mounting test equipment. Complete installation of new equipment requires about two hours.

Upon completion of a test, data is removed from the recording area and sent to the data reduction section for analysis, leaving the facility free to accommodate new equipment. In the meantime, new equipment previously mounted in the test frames is ready for "plug-in" to the environmental chamber. ASD has five plug-in frames.

Ground speed target and altitude simulator for both camera and television reconnaissance systems is mounted on a wheeled cart which is rolled under the chamber. Image from the target simulator is projected into the environmental chamber through openings in the bottom.

Target cart contains complete optics, target controls and other equipment needed for complete terrain simulation, including image motion. Infrared target cart has not been completed.

Test chamber consists of a 54,000-lb stainless steel cylinder lined with 20 stainless steel slats containing heating elements and passages for coolant. The slats can be individually temperature controlled to confront the equipment with temperatures ranging over −100F to 450F from different quarters simultaneously.

Pressure in the chamber can be reduced to 10^{-5} mm. Hg. in 100 min. Test equipment measuring 6 x 10 ft can be accommodated.

To speed testing further, stationary stands remote from the chamber will support camera gear above the mobile target carts for static tests not involving motion or vibration simulation.

Chamber movement is determined by six hydraulic actuators positioned outside which control roll, pitch and yaw. Maximum pitch and roll is ±15 deg. and yaw is ±2 deg.

Within the chamber clusters of three hydraulic actuators, mounted mutually perpendicular, are connected to the four corners of the plug-in frame for vibration testing. Vibration test capability extends from 2 to 800 cps with a maximum displacement of $\frac{5}{8}$ in. or ±5g.

First test on a HR 235 camera with a 12-in. focal length simulated an altitude of 65,000 ft at −65F under conditions of three axis-motion to approximate a typical high altitude mission.

Thermodynamics Lab

North American Aviation's Columbus Div. recently opened a $2.5 million Thermodynamics Laboratory for testing large aircraft and missile fuselage sections at simulated high altitudes and temperature extremes.

The laboratory houses a 16-ft by 75-ft. main test chamber, two other large test chambers and three smaller ones. The two large chambers are used to evaluate complete aircraft venting and air conditioning systems, pressure suits, electronic cooling devices, windshield rain removal and defrosting systems.

Three smaller chambers are used for quality control evaluation of small aircraft and missile components by NAA's production development engineers.

The main test chamber which has a 12 x 12 x 40-ft work space, and is capable of temperatures between −70F and 900F, can simulate altitudes of 120,000 ft.

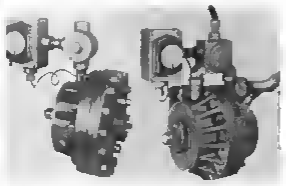
High temperatures are achieved by heating air with two 100-kw resistance elements and circulating it with a 200 hp blower. Low temperatures are achieved by cooling 3,000 gal. of trichloroethelene with dry ice.

NEW AEROSPACE PRODUCTS

High-Pressure Paint Heater

Air-less high-pressure heater maintains paint at uniform temperatures and viscosity at pressures up to 3,000 psi., the manufacturer reports.

The system is capable of heating



vinyl, acrylic and other heavy-bodied coatings for aircraft and missile structures.

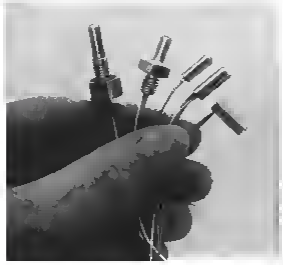
Heater control of paint temperature is accomplished whether or not paint is flowing through the system.

Constructed of aluminum, the 452 & 902 series require 1.5 and 4 kw of power.

Spee-Flo Co., 6614 Harrisburg Blvd., Houston, Tex.

Miniature Resistance Thermometer

Hermetically-sealed platinum element resistance thermometer measures temperatures from −148 to +400F with a



repeatability variance less than 100 parts per million.

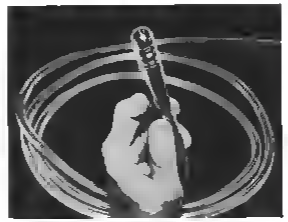
The S31 series thermometers have 0C reference element resistances of 50, 100 or 470 ohms.

The unit is designed for missile, gyro, and accelerometer temperature sensing and laboratory and chemical process control, according to the manufacturer.

Minco Products, Inc., 740 Washington Avenue North, Minneapolis 1, Minn.

Miniature Inspection Camera

Miniature camera and viewer facilitates internal inspection of inaccessible body cavities, flow areas, rocket nozzles, castings, welds, pipelines and turbines. The instrument, called a Cameriscope, incorporates fiber optic viewing through nylon-lined, ¼ in. OD braided stainless-steel cable up to 20 ft. long.

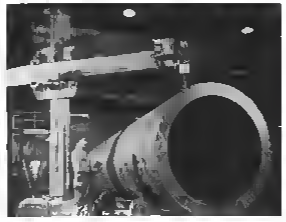


Camera uses 5 mm color or black and white film enlargeable up to 100 times and takes 6-13 stereoscopic or 12-26 single exposures without reloading. Lens system is a modified Tessar triplet with 86 deg. wide angle at f/16 with a resolution of 0.005 in. at 1¼ in. depth of field. Visual coverage of 360 deg. peripheral at insertion depths up to 12 ft. requires ½ in. entrance hole. An integral flash and shutter operates at 30 v. max. to 2 v. min. flash. Camera is ⅝ in. long by approx. ⅜ in. dia. and weights ½ oz. less housing.

Iota-Cam Corp., 555 Boston St., Lynn, Mass.

Welding Head Manipulator

Model 12 x 12 car-type manipulator, automatically controlled from operator's push button pendant, is designed to



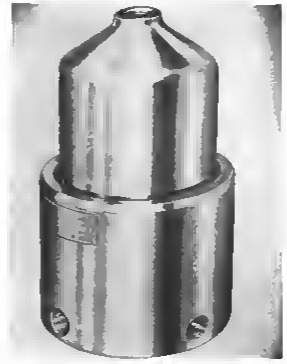
weld girth joints, internal and external flat seams on missile cases, cryogenic tanks and similar equipment.

Any type welding head can be mounted on the manipulator. Mast and boom are mounted on a 4-point thrust bearing riding on a rail-type car, to provide 360 deg. rotation. Maximum vertical boom height is 12 ft., minimum range is 3 ft., horizontal boom travel is 12 ft. Manipulator and car speed are variable between 5-200 in./min. Boom and car are powered by a 220/440 v.d.c. motor. The manipulator weighs approximately 7,000 lb. and is 16 ft. high overall.

Lewis Welding & Engineering Corp., Solon, Ohio.

High-Pressure Oil Filter

Model S-282 oil filter operates at up to 25,000 psi with flow rates of 12 gpm. The all-steel filter is designed for use with hydraulic oils. Filter elements which will remove impurities



from 5-10 microns in dia. can be changed without removing the filter from the system.

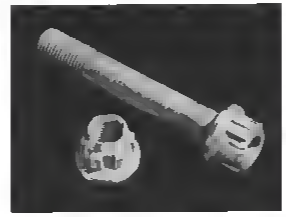
Filter measures 8-⅞ in. high by 4½ in. dia. Inlet, outlet, and bleed connections are ¾ in. female pipe thread, according to the manufacturer.

Pressure drops with a 10 micron element and MIL H-5606 oil at 100F are 63 psi at 12 gpm., 18 psi at 6 gpm. and 5 psi. at 3 gpm.

Sprague Engineering Corp., 19300 So. Vermont Ave., Gardena, Calif.

High-Torque Fastener

External-wrenching, spline-driven threaded fastener is designed for aircraft and missile assemblies.



Repeated screw material failures at tensile ratings of 260,000 psi without spline deformation or wear are reported by the manufacturer. Flanks of the 6-fluted, 12 point spline are at 90 deg. with the fastener centerline fully utilizing torquing surfaces to achieve a degree of preloading previously unobtainable and eliminating the camming action which strips conventional bolts according to the manufacturer. Manufacturer says removal of fastener under severe galling conditions resulting from high temperatures and corrosive atmospheres where removal torque exceeds installation torque is possible.

Spline drive is available on the Aerosciew and Acronut fastener line.

Allen Manufacturing Co., Hartford 1, Conn.

Exhaust Shielding Material

Modified phenolic polymer called NRL 1010 withstood a flame temperature of 6,800F. 8 in. away for 60 sec. with a material loss of 0.027 in. per sec., the manufacturer says.

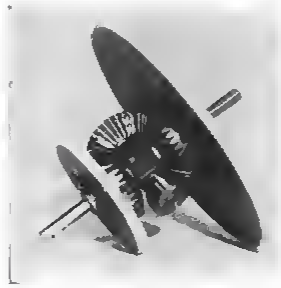
The erosion protection material bonds to steel, aluminum, rubber, glass fiber, epoxies and phenolics using the manufacturer's primer. Specific gravity is 2.9.

Insulation Technology Inc., 5942 Don Way, Carmichael, Calif.

Anti-Backlash Differential

Mechanical differential TS-9 is designed for computer and servo applications.

Zero backlash is maintained by spring-loaded bevel gears, regardless of



service conditions or temperature changes for unit's lifetime, according to the manufacturer.

Starting torque increases slightly from .16 to .6 in.-oz. using this type gear depending on how many teeth are rotated to load the spring. Unit can transmit up to 15 in.-oz. torque at zero backlash.

Sterling Instrument Div. of Designatronics Inc., 76 East 2nd St., Mineola, N.Y.

WHO'S WHERE

(Continued from page 19)

Honors and Elections

Dr. Ludwig G. Lederer, medical director of American Airlines, has received the Aerospace Medical Assn.'s Howard K. Edwards award for outstanding service in the practice of aviation medicine.

Lt. Gen. James M. Gavin (USA, ret.) has been elected president of the Assn. of the United States Army. Gen. Gavin is president and chief executive officer of Arthur D. Little, Inc.

Lt. Col. Miles M. Doyle, USAF, has received the Aviators Post Valor Award for "saving from annihilation a Vietnam army unit and [illegible] landing his crippled plane."

Wilmer J. Garrett has been elected president of the American Assn. of Airport Executives. Mr. Garrett is superintendent of airports for Fresno, Calif.

Changes

William C. Jennings, executive director of the Federal Aviation Agency Regulatory Council succeeding **Lloyd Lane** (AW May 6, p. 118).

Maj. Gen. Henry Viccellio, commander of Tactical Air Command's 19th Air Force, Seymour Johnson AFB, N. C., as of July 1. Also **Brig. Gen. Charles R. Bond, Jr.**, deputy commander TAC's Ninth Air Force, Shaw AFB, S. C., in July.

Dr. F. Lincoln Vogel, Jr., head, Semiconductor Research Dept., Sprague Electric Co., North Adams, Mass.

Northrop Corp.'s Norair Div., Hawthorne, Calif., has named **George C. Crogan, Jr.**, to direct engineering work connected with the company's recent agreement to collaborate with Hawker Siddeley Aviation, Ltd., in the V/STOL aircraft field.

T. C. Pitts, assistant general manager responsible for operations, Boeing Co.'s Vertol Div., Morton, Pa.

Y. C. Lee, technical director of power systems of the newly formed Research and Development Div., Lockheed Missiles & Space Co., Sunnyvale, Calif.

Adam E. Abel, manager, Communications Div., Hughes Aircraft Co.'s Ground Systems Group, Fullerton, Calif.

James O. Mirekles, customer requirements manager, ballistic missile programs, Space Technology Laboratories, San Bernardino, Calif.

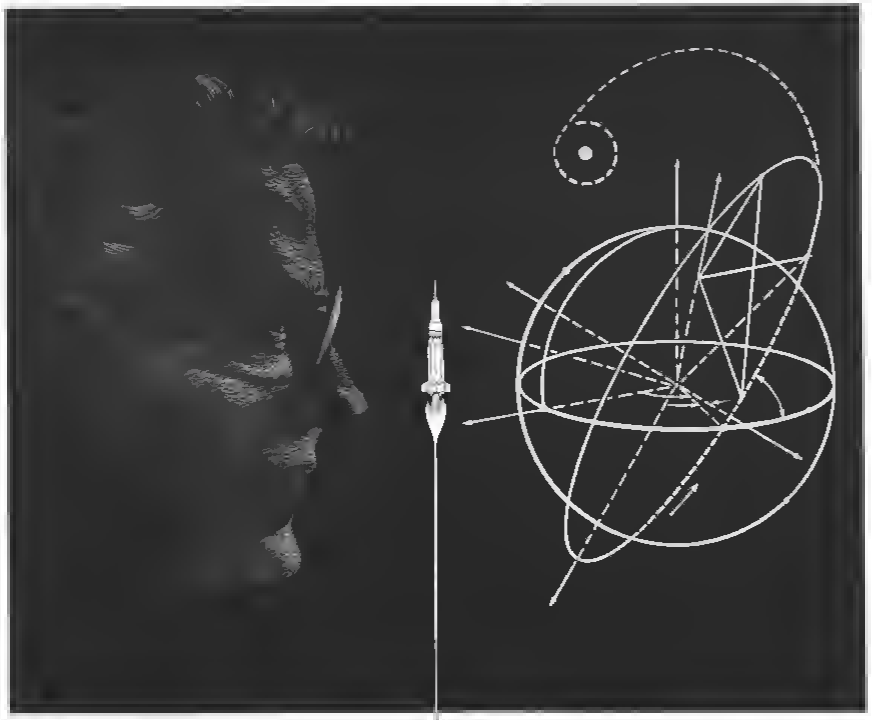
Algert C. Comaila, associate director of engineering, Motorola's Chicago (Ill.) Military Electronics Center.

Fred H. Steuber, staff engineer, manufacturing development, Aircraft Engine Operations, Allison Div. of General Motors, Indianapolis, Ind. **Charles E. Dixon** succeeds Mr. Steuber as manager, parts and service, Aircraft Engine Operations.

James P. Van Etten, director, Airborne Systems Laboratory, ITT Federal Laboratories, Nutley, N. J., a division of International Telephone and Telegraph Corp.

James K. Stuart, chief of Air Force and Advanced Aircraft Marketing, Northrop Norair, a division of Northrop Corp.

James H. Curley, manager, Army Requirements, General Dynamics/Electronics, San Diego, Calif., and **Robert R. Pierce**, manager, purchasing.



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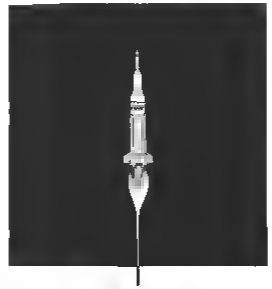

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ELECTRICAL and ELECTRONICS

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LAUNCH FACILITIES

Environmental control systems (launch facilities design including air conditioning systems, cryogenic plants and propellant storage.) Theoretical Launch Facilities Design (feasibility and design studies of future space flight systems, earth orbital and lunar base operations.)

MANUFACTURING

Analyze documentation, determine breakdown of assemblies, define operations sequence and tool requirements, liaison to control product process, tool design and inventory. **Special Equipment Design** . . . Development, design analysis, construction and installation of special equipment, pneumatic and hydraulic or electronic test equipment, special handling techniques in large components.

PROGRAMMERS

Analog Computation (simulate dynamics, aero and astro dynamics, control and guidance systems and closed loop hardware simulation.) Digital Computation (information retrieval, data reduction, scientific computation in trajectory analysis, aerodynamic heating, structural and vibration analysis, aerodynamics.) Digital Programming to generate large scale data processing control system.

QUALITY CONTROL

Supervise and maintain reference of standards in mechanical systems, electrical systems, quality assurance and systems automation, evaluate instructions and test procedures and develop techniques for adapting digital computers for automatic checkout systems.

RELIABILITY

Develop analysis methods and techniques, analysis in electrical, mechanical, electro mechanical, structural, propulsion systems and other areas, evaluate programs, recommend engineering changes.

STRUCTURAL, PROPULSION and RELATED ENGINEERING

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SPACE AND INFORMATION SYSTEMS DIVISION
North American Aviation

LETTERS

G De-Bugged

Military experience General Dynamics/Convair lab tests and tests I viewed at the Phillips Petroleum Co refute reader Walkers statement that "The anti-icing additive (PFA55MB) may or may not inhibit growth of micro-organisms, but it does tend to soften the Buna N Coating and should be used with caution if at all" (AW May 6, p 130).

The military has used the additive for more than a year and no top coating degradation has been reported. Furthermore Convair lab tests—using PFA55MB in the recommended proportions show no softening of the top coating. Experience to date shows that if the subject additive is used in recommended proportions it is an effective biocide.

Ward Mitchell
Senior Design Engineer
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Cosmos Questions

The articles appearing in Aviation Week on Apr 29 (p 22) and in the New York Times on May 4, wherein a review of remarks made by F J Krieger of the Rand Corp is given, prompts these further comments on the Soviet Cosmos series of satellites.

To begin with I should like to take this opportunity to disagree with Krieger on the size of the Cosmos space vehicles launched—as he indicates from the Kapustin Yar site—and placed in orbit with a 49 deg inclination to the equatorial plane. In the era B S (before secrecy) I received quite regularly various ephemerides giving accurate predictions for position and time of passage of all satellites, rockets and debris in orbit. Satellites could be observed with the naked eye on very many occasions provided the night was clear. The Agena satellites were easily seen and observations were frequent. Several associates and myself using the appropriate ephemerides for the Cosmos satellites 1, 2, 3, 5 and 6 were never able to observe them visually. Yet in about a dozen instances we could using Ham receivers hear their radio beacon signals for as long as five minutes at the time of passage. We know, moreover, from geometrical and time considerations that the satellites were not in the earth's shadow. We conclude therefore that these Cosmos satellites are more likely the size of Transit, Tiros, Anna (the geodetic satellite) or Explorer 17 (NASA S 6)—all quite unobservable visually because of their small size. Ergo we would have Krieger present a better case or reduce his estimate of the size of these satellites by one order of magnitude—that is to 440 lb. As an added note we have seen the Vostoks clearly and without using any aids.

I would like to point out one other inconsistency in that same article. If Cosmos 4 and 7 were "precursors to Vostoks 3 and 4" and James Webb of NASA (among others) stated that the Vostok boosters were three stage vehicles, why are the Cosmos' boosters stated—later in the article—to be four stage vehicles? Surely the Soviets are not so naive as to use a four stage booster to simulate the Vostok mission and then use three stages to launch Vostoks 3 and 4.

The accompanying table of figures raises some further questions about the Cosmos spacecraft that are launched into an orbit whose inclination is nominally 65 deg. All of the orbit parameters noted were published in Pravda and Izvestia. Slight deviations from these found in the American press do not change the substance of the question to follow. The intent here is to compare three series of spacecraft whose orbital parameters are very similar. In addition to the same inclination one can observe that all of these spacecraft have relatively low perigees, low apogees and that the nodal period for all cases of interest is less than 91 min. The deviation from the mean perigee altitude for the Vostok spacecraft is more than an order of magnitude less than that of both the Sputnik and the Cosmos spacecraft. Since the dog carrying Sputniks and Sputnik 4 were precursors of (and no doubt very similar to) Vostoks 1 and 2 and certain of the Cosmos spacecraft preceded Vostoks 3 and 4 as "practice" missions one is led to pose this question about the near identity of the Vostok perigees and the spread of values for the perigees of the other two series.

Since most if not all, members of the astronautics community read Aviation Week, perhaps one of them may have an answer to this query.

Sumners B Kramer
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A Critic

Can a citizen of the Republic proffer a few comments on your April 29 editorial "Apollo and Its Critics?"

You write of Eisenhower's inability to understand and cope with technological tides of the era and the perception and vigor with which President Kennedy grasped this fact early in his regime. One must laugh because the average citizen of the United States of America does not understand even today why we must be first to the moon if we must go at all. As proof of this statement listen to the questions asked by reporters on interview shows such as "Meet the Press". Year after year they ask why billions to the moon? The average citizen asks the same question. Why don't you or the Harvard group in Washington explain it to us? Also tell us that whatever progress we have made in the space race is accomplished by the present regime.

In your editorial you also state the Apollo is running close to its optimum technical pace. It's a pity that you don't head NASA, the Defense Department or that Harvard group in Washington. The Republic has too few citizens of the clear thinking omniscient type such as yourself. In your hurry to spend today's billions so that you can get on to the next appropriation of billions you overlook an important point. Billions can and are wasted in this country every year because we are in such a hurry to spend and catch up that we have no time to study yesterday's data. Oh, well I guess I understand. It is all based on your zeal to attack Eisenhower again! I would enjoy seeing this printed in your journal.

Louis L Hansen
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Soviet Satellite Data

Cosmos series	h_p sm	h_a sm	p min	i deg	Δi deg	Δh_p sm	Δh_a sm	Δp min	h_e sm
1	128.4	586.7	96.172	48.92					
2	131.4	960.4	102.25	49.18					
3	126.4	437.7	93.765	48.59					
(4)	185	205	90.563	64°57'	+1.3'	+32.2	−22.2	+.121	195.5
5	126	994	102.72	49°4'					
6	170	223	90.53	49					
(7)	130.5	224	90.1	64°57'	+1.2'	−22.3	−3.2	−.342	177.25
8.	159	375	93.022	49					
(9)	187	219	90.9	65	+4.2'	+24.2	−8.2	+.458	202
(10)	130.5	236	90.2	64°44.4'	−11.2'	−22.3	+8.8	−.242	183.25
11	152	572	96.1	48.9					
(12)	121	252	90.45	65	+4.3'	−21.8	+24.8	+.008	191
Average	152.8	227.2	90.442	64°55.7'	°	°	°	°	189.9
Sputnik series									
4	193.5	225	91.25	64°54'	−1.8'	+48.6	+44.37	+1.724	209.25
5.	190	211	90.72	64°57'	+1.2	−44.96	−20.37	+1.204	200.5
6	116.7	159	88.6	64°58'	+2.2'	−28.24	−21.62	−.916	127.85
9	114	155	88.59	64°56	+.2'	−31.04	−25.63	−.926	124.5
10.	111	153.14	88.42	64°54'	−1.8'	−34.04	−27.49	−1.096	132
Average	145.04	180.63	89.516	64°55.8'	°	°	°	°	162.4
Vostok series									
1	108.74	187.65	89.1	65°4.2'	+5.2'	−1.18	+28.98	+.55	148.2
2	110.40	159.7	88.6	64°56	−3'	+.66	+1.03	+.05	135.15
3	109.8	141.42	88.2	64°59	0	−.12	−17.25	−.25	125.61
4	110.54	145.9	88.3	64°57'	−2'	+.62	−12.77	−.25	128.22
Average	109.92	158.67	88.55	64°59'	°	°	°	°	134.294

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